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| ONR Guidance Document  Guidance on Conducting Criticality Safety-focused Inspections |



ONR Guidance Document

Guidance on Conducting Criticality Safety-focused Inspections

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Contents

[1. Introduction 4](#_Toc143771125)

[Appendix 1 – Criticality Safety Culture 5](#_Toc143771126)

[Appendix 2 – Licence Condition 7: Incidents on the Site 11](#_Toc143771127)

[Appendix 3 – Licence Condition 8: Warning Notices 13](#_Toc143771128)

[Appendix 4 – Licence Condition 10: Training 18](#_Toc143771129)

[Appendix 5 – Licence Condition 11: Emergency Arrangements 29](#_Toc143771130)

[Appendix 6 – Licence Condition 19: Construction or Installation of New Plant 41](#_Toc143771131)

[Appendix 7 – Licence Condition 22: Modification or Experiment on Existing Plant 46](#_Toc143771132)

[Appendix 8 – Licence Condition 23: Operating Rules 51](#_Toc143771133)

[Appendix 9 – Licence Condition 24: Operating Instructions 59](#_Toc143771134)

[Appendix 10 – Licence Condition 25: Operational Records 71](#_Toc143771135)

[Appendix 11 – Licence Condition 26: Control and Supervision of Operations 73](#_Toc143771136)

[Appendix 12 – Licence Condition 27: Safety Devices, Mechanisms and Circuits 78](#_Toc143771137)

[Appendix 13 – Licence Condition 28: Examination, Inspection, Maintenance and Testing 84](#_Toc143771138)

[Appendix 14 – Licence Condition 34: Leakage and Escape of Radioactive Material and Radioactive Waste 86](#_Toc143771139)

# Introduction

1. The following Tables (Appendices 1-14) at their original inception were intended to act as guidance to non-criticality specialist inspectors within ONR, in conducting criticality safety focused inspections during the execution of their normal inspection duties. However, it was recognised that the Tables as previously constructed, provided no guidance to the non-criticality -specialist inspector as to what an acceptable response to the questions within the question sets in the Tables might look like.   
   This provides the background to the re-issuing of the Tables i.e., to provide this missing guidance to both ONR inspectors but also to licensees.
2. It should be noted, however, that more recent Professional Lead guidance within ONR has expressed disquiet at non-criticality safety inspectors conducting inspections within this highly specialised technical area. Accordingly, at its re-issue (to accompany the revised Tables) ONR’s Technical Inspection Guide (TIG) on criticality safety (NS-INSP-GD-053) will contain a minimum requirement that for all criticality safety focused inspections, an ONR SQEP criticality inspector will at the least be involved in, or consulted on, the delivery of the inspection and will ideally lead the inspection.
3. SQEP ONR criticality inspectors are intended to use the Tables as a framework for their inspections and to inform their discussions with licensee personnel, it is not the intention that every ONR criticality safety inspection will rigidly stick to the question set and inspectors at all times reserve the right to pursue other matters that may have been highlighted by licensee responses to a particular question(s). The ‘Expectations’ column in the Tables is only intended to provide guidance on indicative responses and evidence that licensees may wish to provide to an inspector to satisfactorily answer his/her questions. The ‘Expectations’ are not intended to be absolute requirements and the duty remains on the licensee to make their own decisions as to what evidence might helpfully be presented to best answer a particular question.
4. It is a part of ONR’s role is to disseminate areas of good practice from one licensee (or from global practice) across other licensees and to generally try to influence continuous improvement in criticality safety across licensees. However, at all times licensees are at liberty to present reasoned arguments as to why particular improvements are not reasonably practicable and any such arguments will be judged by ONR on their individual merits. Accordingly, ONR would not necessarily expect every ‘Expectation’ to be implemented on every site, provided a licensee can adequately (as judged by the ONR inspector) demonstrate why a particular expectation cannot be met.

# Appendix 1 – Criticality Safety Culture

During inspections, of the criticality safety arrangements put in place across a variety of UK licensees conducted over many years, ONR criticality professionals have formed a view on what evidences a good criticality safety culture within a licensee organisation. The following Tables describe some indicators the non-specialist ONR inspector may wish to look for when judging the ‘health’ of the criticality safety culture on a licensee’s site (the list is not intended to be exhaustive, and the inspector may well identify other indicators that assist in forming judgements as to the adequacy of a licensee’s criticality safety arrangements/management).   
The Tables are not intended to be regulatory requirements, but instead provide indicators to a healthy criticality safety culture within a licensee’s organisation.

## Criticality Safety Professionals

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Can the licensee provide evidence that its criticality assessment personnel are maintaining a focus on their Continuing Professional Development (CPD) in the criticality technical area? | As good practice the licensee should be encouraging its criticality safety professionals to maintain a suitable record e.g. a portfolio of their assessment work undertaken, over a 12-month or other suitable rolling period and/or records of other activities that can be regarded as maintaining their CPD e.g. attendance of internal and external training courses and conferences. Licensees may wish to consider providing a standardised workbook or other suitable means of documenting CPD evidence for their staff | Whilst there is no professional body for criticality assessors in the UK, ONR has in the past encouraged criticality assessors to consider joining the Society for Radiological Protection (SRP), who are supportive of the idea that criticality safety is a technical discipline aligned to its radiological protection mission. As a matter of course SRP requires members to sign an annual CPD declaration and randomly samples evidence from these member declarations. Other professional bodies (e.g., Institute of Physics) are increasingly following this model. The inspector may wish to check which professional bodies individual criticality assessors are members of and whether these bodies themselves expect annual evidence of CPD. |
| 1. Do the licensee’s criticality safety professionals routinely and actively participate in either the UK Working Party on Criticality (WPC) and/or its annual workshops? | Normally a licensee will only be permitted to have a main nominated WPC representative and a Deputy. However, other staff can be invited occasionally as observers; this facility can be used as a good training vehicle for the licensee’s criticality safety staff and the inspector may wish to check whether the licensee has made use of this opportunity. The inspector should also check that the licensee is represented on the WPC. In addition, however, WPC hold an annual workshop on a criticality focused topic(s). The inspector may wish to check that the licensee is making appropriate use of this opportunity for criticality staff CPD and/or what other opportunities for assessor CPD are being routinely accessed by the licensee. | WPC is a sub-group of the Safety Director’s Forum and has long been recognised as the key industry forum for discussion of all matters related to criticality. The WPC meet approximately twice a year and also produce a number of industry ‘good practice’ guides – the inspector may wish to check that the licensee is aware of/utilising such guidance material. |
| 1. Does the licensee actively maintain an up-to-date database of criticality safety reference material e.g., textbooks, conference papers, papers from journals, American Nuclear Society (ANS) publications and archives of its previous assessment work? | The inspector should seek evidence that the licensee is maintaining a well-catalogued library of previous assessment work that is readily accessible to its criticality assessors and also has either paper copies of criticality safety related information (handbooks, conference papers, international reference papers etc.) or can readily access this information electronically.  Evidence should be sought that the licensee’s assessors are well aware of such data and are being encouraged to utilise and add to these data. | The inspector may seek to question individuals within the licensee’s criticality assessment team as to how they would access handbook data, ANS papers, conference papers, etc. and how the licensee continues to build on its knowledge base. |
| 1. How does the licensee keep itself abreast of any relevant research in criticality safety or in the ongoing development of nuclear data-sets etc.? | Normally licensees would be expected to access information by virtue of membership of the UK WPC, as well as the information disseminated by conferences (international and or domestic). The inspector may wish to question the licensee as to how it tries to ensure its criticality safety professionals are kept in touch with UK and international developments in criticality safety. ONR’s expectation would be that the licensee should at least have a broad awareness of ongoing developments in the field of criticality safety. | If a licensee that handles, stores, or processes significant quantities of fissile material does not currently participate in the WPC then ONR would strongly encourage them to do so. |
| 1. Is the licensee active in the production of its own Quality Assured (QA’d) internal documentation, to provide guidance on assessment of the fissile systems commonly encountered during its operations? ONR experience is that most licensees develop their own guidance notes and data, which are often of a high quality, and which ensure that valuable previous work is not lost. | Knowledge capture is important across the licensee’s undertaking, and this should include criticality safety. Often the best way to capture historic knowledge is to incorporate the associated learning into guides etc. for future generations. Inspectors should seek evidence of criticality safety related licensee work in this area and how this is managed, quality assured etc. | Whilst recognising there may be commercial sensitivities, the licensee should be encouraged to share any guidance/assessment data it may have developed, with the wider global criticality community e.g., via the WPC or international conferences. |
| 1. How often do the licensee’s criticality safety professionals conduct inspections of operations on the site and are the findings from these both documented and acted upon? Is there evidence that such inspections are also used as an opportunity to engage with the workforce to try to ensure early identification of problems with implementation of criticality safety rules/working practices etc.? | ONR would expect the licensee to be able to provide evidence that its criticality safety professionals conduct inspections at an appropriate periodicity of all facilities containing a significant mass of fissile material. Ideally such inspections should be shared across its criticality staff (noting that such inspections can be a good learning vehicle for more junior staff when accompanied by a more experienced assessor). Notes or reports of inspection findings should be available, and any actions placed as a result of adverse findings should be demonstrably Suitable, Measurable, Achievable, Realistic and Timely (SMART). The licensee should be able to demonstrate that actions placed have a clear owner and that progress is tracked to closure. The licensee should also be able to demonstrate on what basis actions have been closed (allowing the inspector to make a judgement as to whether closure has been appropriate). | The inspector may choose to observe a licensee criticality safety inspection, in order to be able to take a view as to whether an adequate level of engagement with plant staff/operators is being undertaken by the criticality assessors involved.  It is important that the licensee is able to demonstrate that such inspections add value and do not become merely ‘box ticking’ exercises. |
| 1. Is there clear evidence that the licensee is outward looking i.e., routinely interacts with other licensee bodies to ensure good practice is both sought and adopted where relevant? Close liaison might be expected where licensees are undertaking similar operations. | ONR would expect the licensee to be an active member of the UK WPC but other positive indicators of a healthy culture in this area might include:   * Sharing of training courses/training material with other licensees, * Secondments of assessors to other licensee sites, * Reciprocal agreements to conduct criticality walk-downs on other licensees’ plants/visits to other licensees’ plants * Dialogue/meetings with similar overseas facilities. | ONR recognises that commercial sensitivities may limit what can be achieved/expected in this area. |
| 1. For any cases where the licensee’s criticality safety assessment function is a centralised one, what provision has been made by the licensee to ensure a suitable and sufficient level of enhanced criticality safety expertise is present on the operating sites themselves (e.g., the role of a “Criticality Specialist or Representative” has been established by some licensees, in the case of other licensees the role may be filled for instance by a Safety Case Manager)? However, no matter how this role is resourced in all such cases these personnel are trained to have a more detailed knowledge of criticality safety, without necessarily being trained as professional criticality assessors. The role is intended as a ‘first point of contact’ for the workforce on the site to raise any concerns with respect to criticality safety, or to ask questions/seek clarification on matters pertaining to criticality safety on the site. They act as the liaison between the operating site and the more highly trained professional criticality assessors where these specialists are located away from the licensee’s operational facilities. | Some good models have been observed by ONR of such systems in action (one where the main criticality expertise is remote from the licensed sites and one where Facility Criticality Representatives assist the criticality assessment team, located on the same site but away from the active facilities). The inspector may wish to understand how a given licensee’s model functions and compare it to this type of model, in order to influence the licensee where the implementation of such models may be beneficial to their operations. However, the success of such models relies upon the satellite plant/site specialists having clear roles and responsibilities and a level of training commensurate. Ongoing training and development of the criticality safety specialists at the satellite plants/sites is also required, along with good communications/ working relationships between the satellite plants/sites specialists and the licensee’s central criticality team. Sound succession planning is also required to allow prompt replacement of specialists who may change posts, leave, or retire. | Notwithstanding the implementation of a role such as a Criticality Representative, on sites where the licensee’s criticality experts are working remotely (either from the fissile facilities they are responsible for, or from the site itself), evidence should be sought by the inspector that these criticality assessment staff conduct regular and routine visits to those facilities/sites i.e., to ensure they have and maintain a good working knowledge of the operations within these facilities. The assessors should also be able to demonstrate that they are frequently engaging with the ‘frontline’ workers (in the licensee’s fissile material facilities) who are most at risk from a criticality.  Frequent and effective visits to the active facilities by the criticality assessors and the formation of good working relationships with the key plant personnel offers a significant benefit to efficient and accurate production of criticality safety assessments, and for advance identification of any potential issues/incidents. |
| 1. Can the licensee demonstrate that it proactively learns from operational experience and makes suitable revisions to its assessments and practices where these are judged to be required by the licensee? The licensee should be able to provide evidence that its criticality safety analysis work is reviewed periodically, and as new information becomes available to ensure that this new information (where relevant) is considered appropriately. | The licensee’s criticality safety function should be able to demonstrate that it is engaging with operators, supervisors, and managers on the operating plant to ensure the continued ease of use of the criticality safety assessments and to ensure that any ‘work arounds’ developed due (for instance) to poorly or inaccurately written assessments are promptly identified and addressed.  It is also good practice that the licensee’ criticality safety professionals have access to information on criticality safety related events occurring across the wider nuclear industry (and where relevant other process industries). Such access may be via membership of the UK WPC, by attendance of international conferences etc. | N/A |
| 1. Can the licensee provide evidence that it has adequate working linkages with the wider UK industry and that it actively keeps in touch with criticality safety develops across the global community? | Licensees should generally be encouraged to have and maintain good working linkages with other licensees, the wider global community, and the code developers/ managers (e.g., via attendance of the annual ANSWERS seminar for users of ANSWERS marketed and maintained criticality codes). | N/A |

## Engineering and Shop Floor Staff

The inspector may wish to use the checklist at Appendix 4 (“Training of Other Persons on Site”) when judging the focus, the licensee applies to the criticality awareness training of its operators conducting work with fissile materials.

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. During any walk-down inspection in licensee fissile material facilities the inspector may wish to engage with plant personnel (operators) to judge their knowledge of the key measures (e.g., engineering and/or administrative controls) maintaining criticality safety at their work-front. The inspector should seek to ‘test’ the operator’s knowledge of the key requirements placed upon them by the relevant criticality clearance certificates/point of work instructions. | All staff working ‘hands-on’ with fissile material, together with their supervisors and managers should have a good level of knowledge about the basics of criticality safety and should be able to demonstrate a sound understanding of the limits and conditions keeping them safe whilst conducting fissile material operations on the plant. If plant personnel are not immediately able to answer questions on the criticality limits and conditions, then they should be able to demonstrate that they can readily access on-plant documentation detailing these limits and conditions. | N/A |
| 1. The inspector should make a judgement on licensee tolerance of degraded conditions with respect to criticality safety and this might be evidenced by standing alarms, overly cluttered gloveboxes, poor house-keeping in fissile material areas, accumulations of potentially flammable materials, gaps in and/or signatures missing from plant logs (e.g., of current plant moderator holdings). | The licensee should encourage a high standard of housekeeping across its plant but especially in workstations handling or storing fissile material. A cluttered workstation makes it difficult for operators to easily check fissile stocks and moderator holdings and could in the extreme lead to material overbatching errors. The operators should be very clear on the licensee’s housekeeping expectations and should be actively enforcing the culture. Likewise, good and accurate record keeping, document sign off etc. at the workface is also expected to ensure accurate tracking of fissile material and moderators. | Degraded plant conditions, especially at multiple fissile workstations, can be an indicator of poor safety culture and the inspector should challenge any such observed conditions with a view to understanding how they have come about, what the licensee intends to do about them and on what timescale. |
| 1. When the inspector engages with plant operators, personnel should be able to describe the actions required of them should a breach of a criticality clearance be suspected/occur, or if the criticality alarm were to sound. Are these requirements in accordance with relevant plant documentation? | The operators should be able to describe the key safety actions required of them should a breach of the criticality clearance certificate(s) occur, or should a situation arise outside of their normal expectations. The operators should also be aware of the prompt actions to be taken should a criticality alarm occur.  If plant personnel are not immediately able to answer questions on the required key safety actions, then they should be able to demonstrate that they can readily access on-plant documentation detailing the required actions. | The inspector may seek to question individual operators to gain confidence that they have been well-trained in these key safety actions. Of particular importance is the requirement for operators to understand the need to stop work and evacuate promptly in the event of a criticality warning alarm. |
| 1. Do operating staff in fissile material areas know who to contact with questions regarding criticality safety? | Whilst operators themselves would be expected to have an enhanced level of awareness of criticality safety, ONR considers the use of the plant safety case team (or ‘Facility Criticality Safety Representatives’, or other similar role) appropriate; these individuals will have a more detailed level of criticality safety training and will be available to provide prompt criticality safety advice to operators. Such roles are likely to be a first point of contact with a criticality Subject Matter Expert only being engaged if subsequently found to be required. | The inspector may wish to check that plant personnel know who to go to with any questions/concerns about criticality safety. |
| 1. Do the plant operators have easy access to key criticality safety documentation e.g., the criticality clearance certificates? | It would be expected that the criticality clearance certificates (or other suitable documentation reflecting the limits and conditions necessary to maintain criticality safety) are posted in plain sight on or near the workstation and should be in-date (where an expiry date is posted on the certificates). The posted certificates should be in good condition and should be clearly legible with an absence of operational graffiti.  However, ONR also recognise that some facilities have a large number of Criticality Certificates/or other equivalent documents and some of these may be long documents. Management and upkeep in such circumstances would be difficult. Accordingly, as an alternative such documentation may be lodged at a suitable central location on the plant for example a supervisors or Duly Authorised Person’s office. In any such cases ONR’s expectation would be that only information on the key criticality controls would be posted at the workstation. | The inspector may wish to ensure that the licensee has a clearly allocated responsibility for the maintenance, updating and management of live safety documentation and that this function maintains (as a part of its role) maintains a list of all certificates/criticality related documentation posted on plant with their location and date. The ongoing condition of the certificates/ documentation should be checked as a part of routine plant safety walk-downs. |
| 1. The inspector should seek to ascertain from operations staff that criticality safety professionals and/or Criticality Specialists (see above) visit the work fronts regularly and also seek to actively engage with staff to answer questions, identify problems/work-arounds at an early stage etc. What other management walk-downs are conducted with a focus on criticality safety? | ONR would expect the licensee to have a well-established programme of plant criticality safety walk-downs with due dates and criticality staff allocated to each walk-down. Guidance should also be available to the criticality assessors as to what they should be looking out for during the inspections. As a part of the walk-down the assessors should be able to demonstrate they have engaged with plant personnel and have recorded any key findings/comments from such engagements (and any actions resulting).  ONR would also expect that there is a well-established and documented schedule of plant management walk-downs and that these are recorded. Actions should be noted and tracked to closure. | Note the plant management should also try to actively engage with the Safety Representatives and the licensee’s own Internal Regulator in encouraging these functions to participate in the plant walk-downs.  Previous plant walk-down records should be available to inspectors on request. |
| 1. What supervisor checks, e.g., by a Duly Authorised Person (DAP), are conducted during the conduct of fissile operations and how are such checks evidenced (e.g., by counter-signatures on step-wise process instruction sheets)? | ONR would expect the overall plant safety case to identify key points in the process where for criticality safety purposes direct supervisor and/or DAP oversight is required. For all such points it is ONR’s expectation that the plant point of work instruction would have a suitable hold point that must be witnessed and signed off by a supervisor and/or DAP. The completed sheet should then be retained as a plant operational record. | N/A |
| 1. Some licensees may choose to use computerised systems to oversee/control their movements of fissile material from one location to another. When using such systems, it is ONR’s expectation that the inputs into the computerised systems will be made by trained Nuclear Material Controllers. ONR expects moves to be subjected to independent scrutiny by other trained Nuclear Material Controllers, who will confirm that the proposed move meets the requirements of the Criticality Clearance Certificate/point of work instructions for the destination location, prior to the actual movement being conducted. | Given the likely complexity of any such computerised movement control system, it would be ONR’s expectation that the safety claims made on the system are small and that the processes being ‘policed’ by such systems have demonstrably high criticality safety margins e.g., by the nature and shape of the materials being processed and by the exclusion by design of liquid moderators. | Notwithstanding the low-level claims potentially made by the licensee on such systems, the inspector, when sampling control by such systems may wish to focus on topics such as:   * The rigour of the training provided to the operators and the testing of this training, * The degree of independence in the separate checks being conducted on a fissile move, * The ease of use of the system, * The system back-ups and how potential data corruption faults are managed and * The operating history of the system and its abnormal events. * Etc.   Note for some of the above the inspector may wish to seek additional specialist advice from an ONR Human Factors specialist and an ONR Control and Instrumentation specialist. |
| 1. The inspector may also wish to ascertain how the operators in fissile material areas would be briefed/trained on any change to a process, operations etc. Can the licensee provide evidence of such briefings/training being conducted e.g., logbooks that operators sign onto to signify that they have received and understood the training? Is their evidence of any grading in the training/briefing provided e.g., for very minor changes a short brief may be appropriate but for major/more fundamental changes a period of class-room (or ideally on-plant) training by criticality safety professionals may be more appropriate? | The ONR expectation is that written records will be maintained of any process change briefs that have been rolled out to the workforce. The licensee should be able to demonstrate that it has comprehensively identified all personnel required to receive the new training brief and that access to work on that process will be closed to individuals until the training has been successfully delivered. ONR would expect to see the training material (brief) itself and a log demonstrating that personnel have ‘signed on’ to the training.  The detail of the brief and the way it is rolled out (in some cases classroom training may be appropriate but ideally on-plant training will be utilised) will depend upon the complexity of the process change. | The inspector will wish to assure themselves that the licensee’s criticality safety professionals have been fully involved in both the design and delivery of the training. |

**Note:** When reviewing the licensee’s criticality safety culture, the ONR inspector could seek advice from ONR Human Factors specialists, ONR Leadership and Management for Safety (LMfS) professionals and trained ONR Criticality Safety specialists. The inspector is reminded that good criticality safety culture is not solely indicated by the factors above, although these are good indicators, but also by strong performance by the licensee against some of the points raised later in this guide regarding other Licence Conditions (LC).

# Appendix 2 – Licence Condition 7: Incidents on the Site

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Does the licensee have systems in place to routinely interrogate Operational Experience (OpEx) from elsewhere within its own organisation/the UK/ internationally and how effectively is it using them? | ONR would expect licensees to have well developed systems in place to collate OpEx centrally and disseminate this to various specialist areas (including criticality safety) for sifting and sentencing. | The inspector may wish to sample how OpEx information from within and external to the licensee’s organisation is disseminated to the licensee’s criticality safety professionals. |
| 1. Does a licensee criticality safety professional routinely examine all incident reports on the site/from elsewhere in the licensee’s organisation and beyond e.g., within the wider UK industry and in the international community, to look for any incidents both directly related to criticality safety and those which, although not necessarily directly criticality related, could impact upon criticality safety? | ONR would expect the licensee to have demonstrable well-developed systems for collating information about near misses, incidents, accidents etc. on its own site(s) but also from the wider UK and global nuclear industry, as well as from other industries where this is appropriate. The licensee’s criticality safety professionals would be expected to be provided access to this information and to have systems in place to routinely sift the totality of the information to seek relevant learning for criticality safety. The licensee should be able to demonstrate that such information sifting is routinely taking place across as wide a range of information sources as possible. Where events could have a bearing on the criticality safety of the licensee’s operations, the licensee should be able to clearly explain and demonstrate that it has taken appropriate actions. | The inspector may wish to seek information from ONR Criticality Safety specialists on recent events of interest to the wider criticality safety community and to then follow these through with the licensee, to see what evidence the licensee can offer that the events were considered and where appropriate that the licensee acted. |
| 1. How can the licensee evidence this ‘sifting’ of incidents by a criticality safety professional? | As noted above the licensee should be able to demonstrate its collation of incident information. It should be able to demonstrate how this is disseminated to its criticality safety professionals and then sifted for relevance and how it is acted upon where required. The inspector may wish to ask the licensee what logs, or other documentation are kept providing evidence that such reviews of criticality related OpEx are taking place. | N/A |
| 1. What mechanisms exist within the licensee’s organisation for flagging concerns, identified from the ‘sifting’ of the incident/occurrence reports by the criticality safety professional, to the licensee’s management chain. What mechanisms exist for ensuring that learning is disseminated effectively through the licensee’s organisation (and where relevant, engineering, or administrative improvements are made to improve criticality safety)? | ONR would expect the licensee’s criticality specialists to have a clear reporting chain up through the licensee’s management structure to ensure that issues of importance to criticality safety can be raised. The licensee should also be able to demonstrate an effective means of discussion and decision making for all significant criticality safety concerns. | The inspector may wish to test that these reporting chains and discussion fora are functioning as expected e.g., by seeking examples of recent criticality concerns that have been raised through such chains and the actions that were taken as a result. |
| 1. Can the licensee provide documentary evidence to show that its mechanisms for dissemination of learning through the organisation are being used effectively and where relevant is generating the implementation of improvements? | The licensee should be able to provide documented examples, of where operational experience has been used to drive positive improvements in criticality safety. | The inspector may wish to sample a relevant case study. |
| 1. Is the licensee able to demonstrate that the recommendations from any incident investigations are followed up in a timely manner and satisfactorily closed out? | The expectation would be that all recommendations/actions coming from licensee investigations are properly allocated to an owner and funding/resource stream and then are demonstrably pursued to a satisfactory closure. The license should be able to produce documentary evidence to show this is the case. | The inspector may wish to sample an investigation(s) and to track what the licensee did with each of the recommendations/actions. |
| 1. Can the licensee demonstrate that the incident investigation recommendations are appropriately closed out i.e., via written records with close off being agreed at a suitable management level within the licensee’s organisation? | Again, suitable documented records of close out of all recommendations/actions from incident investigations would be expected to be held and retained by the licensee with closure having usually been subject to scrutiny and agreement at a senior management level in the licensee’s organisation. | N/A |
| 1. Is the licensee contributing to and utilising the WPC Learning from Experience (LfE) database? | ONR would expect all licensees to be aware of this LFE database and to be able to demonstrate both that they have access to it and that they are contributing to the database where relevant and permissible (bearing in mind export controls and security requirements). | N/A |

**Note**: A learning licensee should be able to demonstrate that, where appropriate, enhanced criticality safety measures, both engineered and/or administrative, are developed and introduced into plants as a result of plant experience or other wider OpEx. It is anticipated that OpEx will cover a wide range of topics with a potential to impact upon criticality safety e.g. including false Criticality Warning System (CWS) alarms.

# Appendix 3 – Licence Condition 8: Warning Notices

It should be noted that the term Prompt Evacuation Zone, PEZ, in the Tables below is a term commonly utilised by Sellafield Ltd other terms may be used by other licensees to denote those areas from which a prompt evacuation of personnel would be expected in the event of a criticality alarm being actuated.

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Are appropriate notices displayed to clearly inform staff they are entering/leaving areas or zones subject to prompt or immediate evacuation? | These signs should be readily distinguishable from other warning notices in the vicinity and should be of a sufficient size so as to be clearly legible. | N/A |
| 1. Are the boundaries of areas that are subject to prompt or immediate evacuation clearly marked and are the signs delineating the boundary positioned in sensible locations?   How has the licensee evaluated the required extent of its Prompt Evacuation Zone (PEZ)? | Clearly marked boundaries should include both signage and floor markings, where appropriate (e.g., within buildings).  A sensible location for marker signage could be (where this is practicable) at eye level facing the direction of travel into/out of the criticality control area.  ONR expect that the PEZ extent will be based upon documented dose contour calculations and that such calculations will include clearly justified assumptions with respect to incident yield and dose criteria (balancing deterministic harm versus stochastic risk). | Physical barriers already in place are often used as boundary markers (e.g., facility outer fences and welfare facility exits).  The ONR inspector may wish to sample the licensee’s evaluation of the extent of the PEZ and to ensure the yield and dose criteria have been appropriately justified. |
| 1. Are criticality evacuation routes (where required by the safety case) clearly signed throughout the intended evacuation route i.e., both within and external to buildings? | Sufficient exits from the immediate affected area should be provided to enable rapid and unobstructed evacuation of individuals.  The evacuation routes (where required by the safety case) should be easy to follow (i.e., well-signed all the way along the route both within and external to buildings) to the muster point and should be free of any conventional safety hazards e.g., poor lighting, uneven surfaces and busy access roads. It is ONR’s expectation that the licensee will have a routine inspection activity designated for all such escape routes and that adverse findings from such inspections are addressed promptly.  The muster point should be clearly identified e.g., via the use of signage. | A typical escape route could be sampled during an inspection.  Criticality evacuation routes (where required by the safety case) may be the same as those for other hazards (e.g., fire escape routes). If the two follow different routes, the reasons why should be sought by the inspector.  If there are different evacuation routes (e.g., for fire as opposed to criticality), the different routes should be clearly and readily distinguishable from each other such that personnel are not confused when evacuating. |
| 1. Are all signs, relating to criticality evacuation zones and escape routes, standardised across the site? | ONR would expect signage to be identical across the licensee’s site and across the licensee’s other sites where this is applicable. | N/A |
| 1. Are all the posted signs on a maintenance schedule and how frequently are they inspected and maintained (external signage particularly is prone to weather damage)? | This schedule should include the location, position and type of sign, the written content of the sign and the required frequency of inspection.  Inspections of criticality warning notices should include a check that all appropriate places have been identified where warning notices are necessary.  Whilst ongoing maintenance of criticality related signage across the licensee’s site would generally be expected to be the responsibility of a maintenance department, criticality safety professionals should conduct their own periodic audits of all criticality-related signage to ensure all signage remains accurately positioned and in a good state of repair/legibility. [Note – where there are a significant number of installed criticality related signs, then ONR’s expectation would be that it can be demonstrated by the licensee that a criticality safety professional is conducting inspection of an appropriate sample of the signs with a justifiable periodicity]. | N/A |
| 1. Are responsibilities clear for maintenance and inspection of signage? | The licensee should be able to demonstrate that maintenance of signage (site wide) is detailed on its Asset Maintenance or EIMT (Examination, Inspection, Maintenance and Testing) Schedule and hence that the conduct of such activities is suitably prompted. In addition, it should be unambiguous as to the groups on site responsible for delivering these maintenance routines. | The inspector should seek to sample records demonstrating that inspection and maintenance of signage is on a maintenance schedule, that the work is prompted and generates records of completion and that there are clear lines of responsibility for the conduct of this work. |
| 1. Is due cognisance taken of any required changes to the positioning of the signage in the event of changes on the site (e.g., construction projects and re-routing of access ways) and how is this controlled? | Procedures should adequately cover, in sufficient detail, all matters relevant to the location of warning notices in the event of changes on the site. | Similar principles to those already mentioned above (e.g., readily distinguishable, and unambiguous positioned at eye level where this is practicable) should be followed for repositioning of signs. |
| 1. If criticality evacuation zones extend beyond the site boundary, is signage installed in these areas to clearly direct the actions to be taken e.g. on hearing the criticality alarms (noting that there may be access to such areas by untrained members of the public)? So far as is reasonably practicable the licensee should try to ensure that any access to such areas by members of the public would be unlikely and/or of a low duration. The licensee must be able to demonstrate it is cognisant of these areas and have arrangements in place to ensure they are promptly evacuated and secured against further access for the duration of the event. | Wherever possible the licensee should seek to avoid having designated/signed/alarmed criticality evacuation zones which extend beyond the site boundary that require public understanding/ signage to be acted upon on the criticality alarm sounding. Public protection should be provided by the site’s REPPIR 2019 arrangements, which would be expected to include placement of roadblocks and direct actions to evacuate personnel and direct them away from the affected area.  However, where it is unavoidable that a criticality evacuation zone extends across the site boundary then best practice will be to have these areas closed off to the public, preventing access. However, where this is not possible, adequate signage should be installed and if possible, members of the public should receive an appropriate briefing before entering such areas (e.g., at the security gate house). | All reasonable options for closing these areas off to the public should be explored by the licensee. If this is not possible, explanations as to why should be well documented and accessible for sampling by the inspector. |
| 1. For those licensees where criticality warning systems are required, are alternative visual warnings (e.g., flashing beacons) also installed in, for instance, high-noise areas (known as Noisy Area Warning Lights, NAWL, by some licensees) within buildings where fissile material operations are conducted? | ONR would expect these visual warnings to be readily observable by operators, in all accessible work areas, in such locations. Operators should be trained in the actions they are required to take should the visual warnings activate.  These visual warnings should also be on the licensee’s maintenance schedule with clear evidence that the maintenance is being completed at the required periodicity. | The inspector may wish to visit a sample of such work locations and witness a test of the visual warning signals. Maintenance records and operator training, with respect to required actions on visual warning activation, should also be sampled. |
| 1. For licensees where criticality warning systems are required, are the installed visual warnings triggered by the criticality alarm, for an event that has occurred/is occurring, at all entrances to fissile material facilities to warn workers to keep out of the building? | Best practice would be for activation of the criticality alarms to automatically trigger these additional warnings.  These visual warnings should also be on the licensee’s maintenance schedule. | Criticality visual warnings at building entrances (known as Keep Out Warning Lights, KOWL, by some licensees) should be clear, in a well-maintained condition and be unambiguous in the warning message they provide. The inspector should check they are being routinely maintained and any reported defects are being promptly rectified. |
| 1. For licensees where criticality warning systems are required. are warnings present to prevent vehicles from approaching a building where a criticality event may have occurred/is occurring? | Such warnings may take the form of flashing beacons but ideally should also include automatically deployable barriers that physically limit the approach of a vehicle to the source building.  These warning signs/ beacons/barriers etc. should also be on a maintenance schedule, be routinely prompted for maintenance, be clearly allocated to a maintenance team, and should have defects reported and rectified promptly. | The presence of such warnings/barriers etc. will also require training to staff who may encounter them in a deployed/activated state as to the actions they will be required to take.  It should be noted that for more modern/new facilities the designs will generally be such that the prompt evacuation zones do not extend into areas external to the facility. In such cases the issue of a site instruction prohibiting movement personnel across the site, as a part of the emergency response, can achieve the same (albeit delayed) intent. It is also recognised that it is likely drivers would hear the criticality alarm sounding upon approach to an affected facility.  ONR is cognisant that back-fitting of systems, such as warning lights/barriers, to existing external (i.e., to facilities) prompt evacuation zones may be challenging in respect of infrastructure engineering and cost. ONR will consider any such justifications provided by the licensee on its merits and against existing ONR guidance on ALARP. |
| 1. For licensees where criticality warning systems are required, in addition to the criticality alarm sounding in a building and the warning signs on building entrances etc. are there other visual warnings to advise workers not to approach the building e.g., flashing beacons positioned high on each corner of the building? | Licensees should take suitable and sufficient measures to reduce the risk of workers approaching a building where a criticality event may have occurred or is occurring. Such measures may include, for instance, the presence of visual beacons (triggered by the building’s criticality warning system) placed high up on building corners, which are visible some distance from the source building.  Any installed warning systems should also be on an appropriate maintenance schedule and hence be routinely inspected and tested with appropriate records being available to demonstrate this.  ONR recognise and accepts that back-fitting such systems to existing facilities is dis-proportionate and that a prohibition of personnel movement via a declaration of an Operational Alert or Site Incident can achieve the same (albeit delayed) intent.  For more modern/new facilities a balance of risk should be considered i.e., the risk reduction benefit in a region of low stochastic risk versus other risks such as the conventional safety hazards posed by having to work at height to maintain such systems. | Again, on site personnel should be trained in the presence of any installed warning devices and the actions they will be required to take should such devices be activated. |
| 1. For licensees where criticality warning systems are required, are the installed visual warnings triggered by the criticality alarm, for an event that has occurred/is occurring, at all entrances to fissile material facilities to warn workers to keep out of the building? | Best practice would be for activation of the criticality alarms to automatically trigger these additional warnings.  These visual warnings should also be on the licensee’s maintenance schedule. | Criticality visual warnings at building entrances (known as Keep Out Warning Lights, KOWL, by some licensees) should be clear, in a well-maintained condition and be unambiguous in the warning message they provide. The inspector should check they are being routinely maintained and any reported defects are being promptly rectified. |
| 1. Does the licensee have clear guidance in place, derived from its criticality safety assessments, as to what means of firefighting is permitted in each of its fissile material areas (e.g., are normal means of firefighting permitted such as the use of water hoses or foam, or are restrictions imposed on, for instance, the use of water/foam to fight fires in these areas)? How are the operators trained in respect of their required actions should fire occur?   [ONR accepts that whilst the use of firefighting media, such as water or foam, may be prohibited in the first instance, the progression of the fire may on a balance of risk require the use of such media in due course. Any decisions to subsequently deploy these media will be at the discretion of the senior firefighter attending the incident]. | In the case of fissile material areas where normal means of firefighting are prohibited by the licensee’s criticality safety case ONR expects that:   * Suitable and sufficient training will have been provided to the operators, supervisors etc. working in these areas as to the firefighting restrictions in place and the actions they are to take if fire occurs. * Local firefighting appliances that could be used in error before building evacuation have been replaced by powder or gas appliances. * Adequate information is available to site firefighting responders (and/or to external firefighting agencies) and the site Emergency Control Centre(s) defining which specific buildings have criticality firefighting restrictions. ONR considers it to be good practice to have facility maps available defining building areas of high/medium/low risk for the use of water/foam. * It is good practice for the licensee to work closely with external firefighting agencies who may be expected to respond to fires in its fissile material facilities to ensure their personnel receive adequate training with respect to the unique hazards posed by firefighting in fissile material areas. | The inspector may wish to:   * Ensure that local firefighting appliances are suitable for the permitted firefighting operations in the licensee’s fissile material areas. * Sample the firefighting training provided to the licensee’s personnel working in its fissile material areas. * Sample the information provided to its own and/or external agency fire responders regarding the permitted firefighting media within the licensee’s fissile material facilities. * Sample how the licensee interacts with external firefighting agencies. |
| 1. Is any signage present relating to moderator control in areas where fissile material is present and is the signage clear and sensibly located? | This signage should be located next to, or as close as possible to, the areas where moderator controls are required. It is regarded as good practice by ONR for licensees to maintain logs of the liquid moderator content of each fissile material workstation (logs may also be kept of solid moderators that can have a significant impact on criticality safety for example polythene, Beryllium etc.). | By engaging with operators, the inspector should test their understanding of moderator restrictions at fissile material stations. The quality of any moderator logs kept should be sampled and so far as is possible should be confirmed to be accurate. The inspector may also seek to understand the processes for the maintenance/updating of such logs.  The inspector may also wish to sample the quality of any posted signage related to moderator control and ascertain the inspection and maintenance requirements for such signage. |
| 1. Is suitable and sufficient training provided with respect to the correct interpretation of the meaning of the criticality warning notices? | The correct interpretation and response to the criticality warning notices should be demonstrated by employees, contractors and visitors to the facilities. This can be confirmed by discussions with personnel on plant. | The inspector may also wish to sample the licensee’s criticality training material i.e., to ensure such topics are adequately covered within this training material. The inspector may also wish to understand how the training is delivered to contract staff and/or visitors who may have to visit the fissile material control areas. |
| 1. Has an appropriate person, or management position, responsible for ensuring staff compliance with any criticality warning notices/warning signals within the scope of LC8 been identified (this may typically be the licensee’s LC 8 owner)? | The expectation is that there is a role whose responsibility it is to ensure this compliance across the licensee site. This role does not necessarily need to be a criticality safety practitioner but should have the authority to acquire criticality safety expertise when required. | The role is that of ensuring that a consistent approach is taken, across the licensee site, to compliance with criticality related warning signals/signage. In addition, the role would be expected to oversee the placement of such signs and warning devices and to ensure that the maintenance requirements of all such systems are being undertaken as specified. |

# Appendix 4 – Licence Condition 10: Training

## Criticality Safety Professionals

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Is a structured training programme in place for criticality safety professionals on the site? How can the Suitably Qualified and Experienced Persons (SQEP) credentials of the licensee’s criticality professionals be demonstrated? | ONR would expect the licensee to be able to demonstrate the training programme it takes its criticality safety staff through, and this should be a programme which is aligned with a recognised training framework e.g., the UK WPC’s Competency Framework or other similar recognised training frameworks e.g., ANSI/ANS 8.26. The licensee should also be able to demonstrate how its criticality trainees are then accredited against the licensee’s training requirements e.g., via pieces of work completed and accepted by more senior criticality assessors within the licensee’s organisation and SQEP interviews. Clear records should be kept of accreditation of individual assessors, which should also clarify any limitations placed upon the accreditation awarded. | N/A |
| 1. Is the licensee’s criticality training being conducted with reference to a recognised training scheme/competence framework (e.g., that established by the UK WPC or ANSI/ANS 8.26)? | A comparison should be made between the licensee’s training prospectus for its criticality assessors and national/international guidance (e.g., WPC Competency framework). | ONR’s criticality safety specialism can advise on the suitability of individual licensee’s training schemes for criticality assessors. |
| 1. How have criticality assessor training programmes been developed e.g., has the licensee produced the training programme in isolation, or has reference been made to training material from other licensees, other licensee sites, international web-based training material etc. | ONR considers it to be good practice where practicable and where other considerations do not prohibit it (e.g., commercial sensitivities, security concerns) for licensees to share the training materials they use for developing and accrediting their criticality safety assessors with other licensees.  ONR would also encourage licensees to make suitable use of international sources of material with respect to criticality safety training and note that a significant amount of high-quality material is available from some of the US Laboratories (who in some cases offer free training courses to non-US nationals – more information can be obtained from some of the ICNC 2019 papers –CM9 ref.: 2019/275289).  The licensee may also wish to evidence that it has considered (or is actively involved in) seconding its staff to other licensees to obtain elements of their criticality training, or that the licensee is using experienced criticality personnel from other licensees and/or contractor organisations to provide mentoring/training to its trainee criticality safety assessors. | The inspector may wish to refer the actual training material to a specialist ONR criticality assessor for commentary on its quality and suitability.  ONR criticality assessors, who sometimes have oversight over a number of sources of licensee training material, should also seek to share best practices from this material across licensees (although they should be aware of any commercial sensitivities, security restrictions etc.). |
| 1. How is the progress of the licensee’s criticality assessors measured against the training programme e.g., is there a formal assessment process in place? | ONR would expect that the licensee can evidence some means of measuring the progress its trainees are making against its established criticality safety training prospectus. Typical examples of such evidence would be work completed and accepted by more senior criticality assessors, the results of any tests/exams taken by the trainee relevant to their criticality safety training, notes of SQEP accreditation panels etc. It is also ONR’s expectation that individual trainees will slowly build up a portfolio of evidence to demonstrate their SQEP criticality assessment credentials. | An appropriate manager, for example the manager of the licensee’s criticality safety function, or the licensee’s training lead in conjunction with the mentor and a criticality subject matter expert would be expected to be actively tracking the progress the licensee’s criticality safety trainees are making towards accreditation. The licensee should be able to show documented evidence of this tracking and also show that appropriate actions are being taken where trainees are slipping against achievement expectations.  In recognition that not all trainees will necessarily be suitable as fully SQEP’d assessors, the licensee’s criticality safety lead may wish to establish a number of roles across the licensee’s criticality safety team to which assessors may be SQEP’d e.g., for the execution of criticality calculations, or for the authoring of criticality safety cases. |
| 1. Does the licensee routinely reassess its training programme e.g., to incorporate new ‘best practice’ guidance? | ONR would expect the licensee’s criticality safety assessors to be closely in touch with developments in criticality safety e.g., via bodies such as the UK WPC, the sharing of OpEx (both UK and global) between licensees and the attendance at external criticality focused training courses, seminars, and workshops. Using the knowledge gained from such interactions it is an ONR expectation that the licensee will routinely re-examine its training programme for its criticality assessors, to ensure new learning (where relevant) is incorporated.  Each licensee should be able to evidence that its criticality training material is evolving to keep pace with global developments in criticality safety practices. | It would generally be expected that each licensee will revisit its training material on a circa 3 – 5-year periodicity, however particular events or developments in criticality safety could reasonably be expected to prompt the licensee to revisit its training between such dates. |
| 1. Is there clear evidence of continuing professional development (CPD) of criticality assessors on site? The licensee should be able to provide a demonstration that its criticality safety personnel are maintaining their professional qualifications with suitable bodies, such as the Institute of Physics or the Society for Radiological Protection (there may be other professional bodies that are relevant). | The licensee should be encouraging its criticality safety professionals to maintain records of their assessment work undertaken over a 12-month rolling period and/or other activities that can be regarded as maintaining their CPD. Licensees could be encouraged to provide a standardised workbook for their staff to be completing in this area. | Whilst there is no professional body for criticality assessors in the UK, ONR has in the past encouraged criticality assessors to consider joining the Society for Radiological Protection (SRP), who are sympathetic to the idea that criticality safety is a technical discipline aligned to its radiological protection mission. As a matter of course SRP requires members to sign an annual CPD declaration and randomly samples evidence from these member declarations. The inspector may wish to check which professional bodies individual criticality assessors are members of and whether these bodies themselves expect annual evidence of CPD. The inspector may also choose to sample the evidence submitted by individual assessors to such bodies. |
| 1. Where mentoring is being used as a vehicle for training new assessors, the inspector may wish to question the licensee with respect to what training the chosen mentors have received to deliver this role (who trains the trainer?) and how their performance is assessed (noting that some people are more natural mentors than others). | The licensee should be able to evidence, via its training records, that the mentors it has assigned to the training of criticality assessors have received an appropriate degree of recognised training for the delivery of their mentoring role. The licensee should also be able to demonstrate that it has a programme of ongoing support for its mentors e.g., mentor communities to share experiences and problems and/or ongoing training in ‘soft skills’ (this list is intended to be indicative only).  In addition, and particularly when mentors are new to their role, there should be ongoing and demonstrable evaluation of their performance, with intervention to assist any mentors who are failing to achieve the required standards. It is suggested that mentors are subjected to a probationary period in the role, with a clear expectation that personnel found not to be suited to the role during the probationary period will be returned to other duties. | N/A |
| 1. The inspector should ensure that mentors are not over-stretched by requirements to both fulfil their normal assessment duties and to mentor new trainees (this includes being over-allocated personnel to mentor). Can the mentors deliver their mentoring functions in a timely and efficient manner or is there evidence that mentoring is slipping due to conflicting priorities? | Mentors should be given time to adequately discharge their duties and to provide adequate ‘face-time’ to those they are mentoring. Mentoring should not be an ‘add on’ to what may already be a busy day job for a mentor. New trainees undergoing mentoring should have a structured training programme to progress through at a reasonable pace that doesn’t put unrealistic expectations for delivery on the mentors. Likewise, the allocation of too many trainees to one mentor may cause the mentoring programme to slip and put undue stress on the mentors. Inspectors should seek evidence from the licensee that its mentors can easily cope with the demands placed upon them. | The inspector may wish to conduct one-to-one discussions with a sample of the mentors to ensure the licensee has realistic and achievable expectations of these personnel. |
| 1. Do mentors have support networks to assist them, e.g., to coordinate on the job training and to allow best practice between mentors? | Inspector should seek evidence such as:   * Mentor seminars, * Ongoing training days for mentors, * Communities of practice for mentors. * Etc.   The list is only meant to be indicative; the inspector should be seeking evidence that the licensee’s mentors are being actively assisted and continue to be developed in the execution of their roles. | Learning from international experience has suggested that it is good practice and beneficial for mentors (especially those new to the role) to have ongoing established support networks in place. Accordingly, it is appropriate for ONR inspectors to ask whether mentors have appropriate support networks to assist them in discharging their duties. |
| 1. For multi-plant/multi-process sites, is there a process for demonstrating the Suitably Qualified and Experienced Persons (SQEP) credentials of individual assessors to assess particular plants/processes? | The criticality considerations during decommissioning operations, compared to (for instance) glovebox processing operations, compared to fuel reprocessing operations in a nuclear chemical plant, compared to assessment of transport operations related to fissile material etc. vary (in some cases quite markedly). Not all assessors will necessarily possess all the required skill sets, nor do they necessarily need to (e.g., an individual assessor may have a particular aptitude in the assessment of transport operations and the licensee’s operations may dictate that this constitutes a full workload for this individual). However, the licensee should be able to demonstrate what criticality skill sets apply to which individual assessment area and should be able to demonstrate therefore which assessors can be deployed on what kind of assessment work. The licensee should be able to demonstrate how it has made individual assessors SQEP against each of its identified assessment types.  In addition, ONR consider it good practice for the licensee to track work conducted on a particular assessment type by each assessor, so that if an assessor is a SQEP for a particular assessment type the accreditation can refreshed (e.g., by a refresher course, conducting an assessment under supervision or by a period of mentoring if the assessor has not exercised the skills set for a defined period of time.  However, ONR also recognise that the licensee may wish to maintain flexibility of assessors at multi-process sites and rather than having a formal accreditation process in place, such as that described above, it is permissible for an assessor to work across different areas, provided that the licensee can demonstrate that assessments produced by that assessor have been quality assured by a criticality assessor who is SQEP in that area and that the assessment is ultimately approved by the criticality technical lead for that area. | The inspector may wish to question the licensee as to how it has differentiated between the criticality assessment skill sets for particular assessment types and to seek advice from an ONR criticality specialist as to whether the licensee’s scheme appears reasonable. |
| 1. Is there a clear grading system for the licensee’s assessors and is there a clear job description for each grade, to ensure that the checking/sign off of criticality assessment work is only permitted by more experienced staff? | It is expected that as the licensee’s criticality trainees gain more assessment experience and more criticality knowledge, this will be recognised within a grading structure (which in itself is likely to assist staff retention and career development within the criticality technical field). However, the licensee should be able to clearly articulate (in a documented scheme) what specific knowledge/assessment experience an assessor must gain/demonstrate in order to move between the licensee’s various grades within the criticality assessment technical discipline. The licensee should also be able to show how assessors are examined/assessed before being moved onto a higher grade.  As an assessor moves up the grades, the levels of responsibility assigned to the assessor are also likely to increase. The inspector should be looking for documented delegations across the assessment grades e.g., at what grade can an assessor Peer Review other assessment work, at what grade is an assessor permitted to sign off calculations as being accurate and who, within the criticality safety group, has the authorisation to sign criticality assessments off for implementation?  The licensee should have clear criteria where assessors must be supervised by a more experienced assessor in the conduct of criticality assessment work and where an assessor is allowed to work unsupervised or is permitted to lead a project being worked on by other assessors. | Again, the inspector may wish to consult with an ONR criticality safety professional to ensure that licensees are expecting a suitable level of assessor attainment to be demonstrated before assessors are allowed to sign off important QA steps in the generation and issue of criticality safety assessment work. |
| 1. In the case of an assessor not having worked on a plant/process for a length of time, is there a process for revalidating their awareness of that plant/process prior to them commencing criticality safety assessment work? | The licensee should be able to demonstrate that it tracks work conducted on a particular assessment type by each assessor, so that if an assessor is a SQEP for a particular assessment type, the accreditation can be withdrawn or suspended (pending re-demonstration) if the assessor has not exercised the skills set for a defined period of time. However, in addition the licensee should be able to demonstrate a documented, evidence based, process by which an assessor can be re-accredited for a type of criticality assessment work where their former SQEP status has been suspended. | Revalidation training may also be required in the event of any change to a process or plant that an assessor is involved with. |
| 1. Noting a need for overall balance and the requirement to allow individuals to develop evidence for SQEP accreditation, the licensee should be able to demonstrate that the balance of the overall team is SQEP i.e., key authors should be SQEP but can be supported by other workers who are not, thus allowing these non-SQEP individuals to work towards SQEP accreditation. In the case of smaller projects, the use of SQEP ‘checkers’ and peer review can assist in allowing a lapsed SQEP to be revalidated. | In the development of more junior non-SQEP assessors, it is ONR’s expectation that these would be closely supervised in the execution of well-defined tasks. However, as their experience increases, they may be expected to have increasingly more influence in the scoping of the project work, but again in close consultation with more experienced assessors. All evidence for SQEP accreditation should be documented (for possible ONR sampling) as an individual develops. The licensee should have a clear point at which an assessor is permitted to conduct assessment work largely unsupervised and should be able to articulate this delegation point. | As noted, a route to re-instigating the SQEP status of an assessor against a task, for which they were previously a SQEP, might be in assisting with aspects of an assessment being undertaken by SQEP assessors in that field. |
| 1. How has the licensee established a baseline of the number of personnel it requires in its criticality safety group and how often is this baseline reviewed? | The licensee should be able to demonstrate what its typical criticality assessment work levels have been over the last year/few years and that it has a good picture of what the demands are likely to be on its assessment resource going forward over the coming months/year/5-year period.  The licensee should also be able to demonstrate from analysis of production of past assessments, the typical time various types of criticality safety assessment commonly take to complete from project commencement. [It is accepted that such estimates will often be subject to considerable degrees of uncertainty, but the licensee should be able to demonstrate it has some tools/operational experience at its disposal for future work and resource planning].  From its previous project execution, the licensee should be able to articulate how many assessment personnel; across the assessment grades (from juniors to more experienced assessors and those involved in calculation checking, peer review etc.) it typically requires undertaking a criticality safety assessment. Furthermore, the licensee should also be able to explain the non-assessment demands commonly placed upon its staff e.g., support to emergency response, delivery of criticality awareness training courses and mentoring and other company responsibilities. From all of this information, it is ONR’s expectation that the licensee will be able to draw up a typical baseline estimate of the level of criticality resource it needs to deliver its service on an annual basis. | The inspector should question the licensee as to how it has estimated its required criticality assessment baseline. The previous column describes the typical thought steps the inspector might reasonably expect the licensee to have gone through in establishing its baseline.  The licensee should also be able to demonstrate that it has a process in place which requires a routine review of this baseline. |
| 1. What succession planning does the licensee have in place for criticality safety professionals? | In recognition of the current demographic in UK criticality safety professionals the licensee should be able to demonstrate it actively considers succession planning at appropriate junctures in line with its expectations of an annual substantiated turnover level of staff and its knowledge of the likely retirement plans of its older staff. Where the licensee’s team is supported by supply chain staff the licensee should also be planning for the likely loss of any of these personnel (especially where they occupy more senior positions within the licensee’s team). ONR encourages licensees to be actively supporting the training of ‘new blood’ into its criticality safety assessment teams where possible and in line with a licensee’s business needs. | The licensee should be able to demonstrate that its succession planning is credible i.e., that it has made realistic estimates of the time it takes to make new assessors SQEP and has considered the licensee’s expected future criticality safety assessment workloads.  Undue reliance upon supply chain staff to fulfil key positions indefinitely should be avoided by the licensee where possible. |
| 1. In the case of the licensee’s criticality safety professionals required to respond to events/emergencies, have these individuals received appropriate training to assist them in coping/performing in what are likely to be pressured situations? | Some of the licensee’s criticality safety professionals may be called upon to provide criticality safety advice in emergency situations and in such scenarios (which ONR accept will be very pressured) additional ‘softer skills’ may be required by the assessors to allow them to adequately discharge the role. Accordingly, it is ONR’s view that it is good practice for the licensee to have considered the full range of skills that its criticality safety professionals may require for such roles and to be able to demonstrate that it has sought to equip a sub-set of its more experienced criticality safety professionals with those additional skills necessary to allow them to discharge their emergency duties competently.  For example, it is recognised that in addition to having achieved SQEP assessor status, the licensee’s criticality assessment personnel are also likely to need training in a range of behavioural skills e.g., how to respond to stressful/pressured situations and how to verbally communicate effectively (this list is only intended to be indicative). ONR inspectors may choose to ascertain whether the licensee has sought/obtained expert advice on the full range of skills likely to be required by criticality assessors in such situations, has considered what additional training may be required and has ensured that its assessors have been provided with the required training before being exposed to emergency response situations. The licensee should also ensure that assessors nominated for emergency response roles are provided with ample opportunities to practice their roles under realistic exercise conditions. | The inspector should seek a full listing of the courses criticality safety assessors designated to be emergency responders are expected to attend to achieve accreditation. Advice on the suitability of the training should be obtained from appropriate ONR experts. Documented evidence of attendance of the required training courses should be sought for a sample of the designated emergency responders and evidence should be provided that the training is routinely refreshed. Evidence should also be provided of attendance of the designated responders at emergency exercises. |
| 1. How much time on average do the criticality assessors actually spend on the plant(s) they are responsible for assessing? Are assessors seconded for periods of time to gain plant experience? | Criticality assessment cannot accurately and effectively be conducted remote from the plant/equipment which is being assessed i.e., the assessor must gain familiarity with not only the plant and equipment but how it is (or is intended to be) operated. A significant amount of time must be dedicated to this activity if a comprehensive and accurate criticality safety assessment is to be produced. It is hence of importance that assessors devote an adequate amount of their time to presence on plant and interact effectively with plant operators, supervisors, maintainers etc. whilst on the plant.  Particularly whilst assessors are engaged in achieving SQEP status it may be appropriate to consider periods of secondment to plant operations.  For example, it is recognised that in addition to having achieved SQEP assessor status, the licensee’s criticality assessment personnel are also likely to need training in a range of behavioural skills e.g., how to respond to stressful/pressured situations and how to verbally communicate effectively (this list is only intended to be indicative). ONR inspectors may choose to ascertain whether the licensee has sought/obtained expert advice on the full range of skills likely to be required by criticality assessors in such situations, has considered what additional training may be required and has ensured that its assessors have been provided with the required training before being exposed to emergency response situations. The licensee should also ensure that assessors nominated for emergency response roles are provided with ample opportunities to practice their roles under realistic exercise conditions. | N/A |

## Other Persons on Site

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Are all personnel on site, from the most junior to the most senior, subjected to an adequate level of criticality awareness training? | On sites where fissile material operations are performed, the actions of all personnel have at least a potential to adversely affect criticality safety. Accordingly, it is appropriate that all personnel (including contractors) have at least an appreciation as to what nuclear criticality is and the main factors affecting criticality. ONR’s expectation, however, would be that the level of criticality training is commensurate to the likely exposure of personnel to fissile material e.g., general office workers would be expected to have only general awareness training, whereas boxline workers handling/processing fissile material would be expected to have a much more enhanced level of training. In addition, senior managers, whether or not they are involved in routine fissile material operations, would be expected to have a more enhanced level of criticality safety awareness training. | The inspector may wish to sample the licensee’s criticality safety training material and to seek advice from an ONR criticality safety specialist as to whether the material is comprehensive, appropriate for the level of awareness training required and is consistent with other UK licensees. |
| 1. How quickly does the criticality awareness training have to be delivered after a person’s arrival on the site? If the training is delayed for any reason, what interim arrangements are in place for supervision of untrained personnel in fissile material control areas? | ONR’s general expectation is that personnel will not be allowed to work in fissile material areas until such time as appropriate criticality safety awareness training has been successfully completed. However, in exceptional circumstances personnel could be allowed to access such areas, but only if directly supervised/escorted by a trained member of the licensee’s staff and with the expectation that access would not be allowed in circumstances where any direct working with fissile material was required.  For those workers not accessing fissile material areas as a part of their work, access to their work areas could be permitted in the absence of delivery of the criticality awareness training, but it may be appropriate to deliver a basic brief to such persons in advance of training delivery. | The inspector may wish to ascertain how often criticality awareness training courses are run and sample the licensees arrangements for personnel awaiting delivery of such training. |
| 1. How frequently do personnel on the site have to undertake criticality awareness refresher training? | There should be a recognition by the licensee that criticality awareness training is not a one-off requirement, i.e., that the training should be periodically refreshed for all staff. The licensee should be able to justify the periodicity it has chosen for refresher training and provide documentary evidence that the requirements for such training are flagged to staff a suitable time before expiry of their training. Records should be available to demonstrate staff are being subjected to the refresher training in a timely manner. The licensee should also be able to describe the arrangements in place for staff that exceed their refresher training requirements.  In addition, it is noted that ONR would expect that should staff subjected to the more basic criticality safety awareness training move to duties in fissile material areas, then such staff would undertake more advanced criticality safety awareness training in advance of commencing work in such areas. If training is not possible in advance of commencement of their new role, then ONR would expect the licensee to have mitigating measures in place e.g., no hands-on work with fissile material being permitted and increased levels of supervision. In general, any staff working in fissile material areas should be subjected to enhanced levels of criticality safety awareness training and this training also should be subjected to periodic refresher training. | The inspector may wish to examine training records for evidence of refresher training being completed in a timely manner and may also wish to sample the licensee’s systems for prompting training. |
| 1. For all criticality training material, how is the depth of understanding of personnel exposed to the training judged e.g., is there a test at the end of the training with a set pass-mark? | ONR would expect criticality awareness training courses (both general level and more advanced level) to be subject to a test with a defined pass mark which is suitably challenging. The licensee should be able to describe its arrangements for those personnel failing the test, which may initially involve some 1 to 1 tuition on the perceived areas of weakness, followed by a re-test, to (in more extreme cases where a person continues to fail the test), exclusion from fissile material areas (e.g. by suspension of access passes). | N/A |
| 1. Is criticality training material standardised across the licensee’s sites and if not why?    1. If the training material is not standardised, has the licensee benchmarked the material across their sites to ensure the training delivered is of a consistent quality? | It is expected that generally a licensee’s criticality training material will be standardised across all of its fissile material sites, although differences in plant or operations across sites may necessitate parts of the training being bespoke for a particular site. However, the key aim should be to deliver a consistent standard of criticality safety training across the licensee’s sites (and this training would be expected to be generally consistent with the rest of the UK industry). | The inspector may wish to sample training material from across a number of the licensee’s sites and to ask for an ONR criticality specialist’s view as to the quality of this material in comparison to other UK licensees. |
| 1. How often is criticality training material reviewed/updated to take account of UK and International OpEx? 2. What is the licensee’s process for reviewing/updating criticality training material? | It is expected that the licensee ‘refreshes’ its criticality training material on a periodicity that the licensee has considered and can justify. The licensee should be able to describe the process it uses to review all of its training materials (including its criticality safety awareness training – which ONR would expect to be done in close consultation with the licensee’s criticality safety professionals). At the time of training material refreshment, the licensee should consider all relevant criticality OpEx, from the global criticality community and include any relevant examples within the revised training materials. | The inspector may wish to sample how the licensee goes about updating its criticality safety awareness training material, how often this is conducted and whether the licensee reviews international OpEx that has occurred since the training was last reviewed. |
| 1. If the licensee uses a third party to deliver criticality safety training to its personnel, how does the licensee discharge their Intelligent Customer requirement in this area? | It is expected that if a third-party provider is used to deliver criticality awareness training, that licensee criticality safety personnel will be intimately involved in the production of the training material and will ideally be present at the time of the training delivery, or as a minimum will periodically sample the quality of the training delivery (documentary evidence should be available to demonstrate this sampling). The licensee should also be able to demonstrate that its criticality safety personnel are working closely with the training delivery agent to ensure continuous improvement to the training material. Licensee criticality safety professionals should also be closely involved in the licensee’s periodic reviews of its criticality awareness training materials. | N/A |
| 1. If the licensee does not have a dedicated criticality safety group on site, is a person(s) identified who has an enhanced level of criticality safety knowledge and to whom personnel can direct criticality related questions? | Experience has shown that it is beneficial for safety reasons (e.g., to avoid workers developing potentially unsafe ‘work-arounds’) to have (in the absence of a group of trained criticality safety professionals on the site) a person with sufficient criticality safety knowledge that operators with criticality safety concerns/questions can go to as a ‘first port of call’. This individual can either provide an immediate answer to the question or concern or can act as a conduit to the licensee’s criticality safety professionals to ensure a more definitive and informed answer to the question is provided. This role should be well publicised on the site so operators know who to go to and the person occupying the role should seek to routinely engage with the operators to seek any questions/concerns. It is ONR’s expectation that this person will be supplied with an appropriate level of criticality safety training to allow him/her to adequately discharge the role. | The inspector may seek to ascertain whether the licensee on a particular site has a need for such a role(s) and if so whether it has personnel allocated to such roles. The inspector may also wish to question how these persons are trained for the role and how the licensee has publicised the role across its site workforce. |
| 1. What training is provided for the criticality ‘first port of call’ role and how is it evidenced that the person(s) has received and successfully assimilated the required degree of training? | ONR’s view of good practice in this area is that such individuals would receive detailed criticality safety training (probably over a number of days), as well as having to complete a ‘mentor guide’ on key criticality safety topics, tailored to that licensee’s operations, within a certain timeframe prior to being subjected to interview by a senior and recognised criticality safety professional(s) and subsequent formal appointment. | It is noted that at some sites this ’first port of call’ role may be fulfilled by the Safety Case Manager and his/her team members.  The inspector may wish to seek the opinion of ONR criticality safety experts as to the quality of training provided to any occupant of such a role and to the rigour of testing applied to the individual prior to formal appointment to the role. |

# Appendix 5 – Licence Condition 11: Emergency Arrangements

The following paragraphs are only intended to be applicable to those fissile material sites where criticality detection and alarm systems are installed and hence where there is a consequent requirement for criticality emergency evacuation arrangements to be in place. These paragraphs are not valid where the licensee has robust quality assured criticality warning system omission argument in place.

The term Prompt Evacuation Zone, PEZ, is a term commonly utilised by Sellafield Ltd other terms may be used by other licensees to denote those areas from which a prompt evacuation of personnel would be expected in the event of a criticality alarm actuating.

Whilst the UK Working Party on Criticality (WPC) has indicated that all UK nuclear sites can conduct their own triage monitoring following a criticality event, only some nuclear sites have detailed criticality accident dose assessment capabilities, with other sites having arrangements in place for this assessment capability to be delivered by other nuclear sites or service providers.

## Evacuation

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Does the training of the licensee’s operators in fissile material control areas ensure that they would evacuate immediately upon hearing the criticality alarm? Are operators aware of the marking of the evacuation routes? | Prompt worker evacuation in a criticality can significantly reduce the radiation dose to which they are exposed. ONR expects that all workers will have been trained to evacuate **immediately** upon the criticality alarm sounding (i.e., without stopping to make the plant safe) and will do so via the nearest marked evacuation route, proceeding to the designated Assembly Area. Accordingly, it is ONR’s expectation that any worker on the plant will know from his/her current position, where the nearest evacuation route lies. | The inspector may wish to engage with operators encountered on the plant to ensure that ONR’s expectations will be fully met in the event of the criticality evacuation alarm sounding and that workers can clearly distinguish the criticality alarm from other plant alarms. |
| 1. Are there routine plant/local exercises based upon a criticality event scenario? | ONR’s expectation is that the licensee should periodically demonstrate its ongoing ability to promptly evacuate its fissile material facilities and to promptly account for all personnel in the event of a simulated criticality event. | A balance must be struck between the desirability of ensuring the evacuation arrangements, routes etc. all function smoothly, weighed against the conventional health and safety risks of personnel evacuating a plant in a hurry. It is unlikely that in an exercise it would be justified for personnel to run from a facility. The inspector should check that for any planned criticality related exercise that all risks are being adequately considered and balanced. |
| 1. Has the licensee considered the make-up of its workforce and hence the ability of all its workers to evacuate promptly in the event of a criticality e.g., does the workforce contain any personnel who are hard of hearing and hence may not hear the alarm, does the workforce contain disabled members who may not easily be able to negotiate stairs? | The licensee should be able to demonstrate that it has a sound understanding of any special health needs of all its personnel working in fissile material areas and should be able to demonstrate that the ongoing presence of such personnel in such areas has been adequately justified. In addition, the licensee should be able to demonstrate that appropriate and credible emergency arrangements are in place, to ensure the ongoing safety of all such personnel, in the event that a criticality occurs. | The inspector should ascertain whether the licensee has any personnel, working in fissile material areas, who have hearing, mobility, or other health issues that might impede their rapid egress from the facility in the event of a criticality. The licensee should then be able to demonstrate the criticality evacuation arrangements for such personnel and show any required special equipment (e.g., wheelchairs) is readily available. |
| 1. Do the licensee’s operations require workers to access remote areas, which may be within the potential criticality dose contours and from which prompt evacuation is also required, where the criticality alarm and/or visual indications of a criticality (e.g., flashing beacons) may not be audible/visible? What arrangements has the licensee made to warn such workers of the occurrence of a criticality and hence ensure their prompt evacuation? | ONR would expect the licensee to be aware of any such areas, across its site, where the criticality dose contour necessitates evacuation in an emergency. The licensee would also be expected to recognise that all personnel, visiting or working in such areas, would be given an adequate pre-job brief identifying the situation and advising them as to how they would be contacted if a criticality event were to occur. It is expected that any such workers would be issued with a communication device e.g., a mobile phone (provided the signal at the location has been demonstrated to be adequate) or a radio, to allow such personnel to be alerted promptly should a criticality event occur. | The inspector may wish to ascertain how the licensee has identified any such areas, where these are recorded and how access to any such areas would be flagged as requiring a briefing to the worker. The licensee should be able to provide an example of the brief provided to any workers accessing such areas and to articulate how the worker would be informed of a need for prompt evacuation. |
| 1. Are the marked evacuation routes free from obvious conventional safety hazards e.g., are they well-lit at night, are they free from obvious trip hazards, is anything present that could block the route, do workers have to cross busy roads? | The licensee would be expected to have well marked criticality evacuation routes and should have routines (ideally on a maintenance schedule) requiring that these routes are periodically walked to ensure they remain free of conventional safety hazards. The licensee should be able to justify the periodicity of any such inspection routines and should be able to demonstrate that any problems identified on the walk-down are allocated a clear owner responsible for the prompt rectification of the problem. | The inspector may wish to sample some of the evacuation routes via his/her own walk-down. Sampling of the licensee’s reports of the walk-downs may also be useful, allowing the Inspector to see the types of problem encountered and to see evidence that these have been addressed promptly. |
| 1. Do the marked evacuation routes generally serve to direct workers away from the potential seat of a criticality incident? | In order to guard evacuating workers from potential additional ‘pulses’ of radiation from the criticality, it is desirable to ensure, so far as is reasonably practicable, that all evacuation routes take workers away from the likely seat of the criticality or direct them along routes that make the optimum use of any installed shielding provisions on the facility.  It is recognised that in some facilities where there are multiple potential incident locations, these aspirations may be very difficult. In such circumstances ONR inspectors will take a balanced judgement as to whether risks have been minimised.  ONR also accept that the aspiration of directing workers away from the potential seat of the criticality may be challenged by conflicting facility security requirements giving rise to difficult and challenging judgemental balances and justifications. In any such cases (each will be judged by ONR on its particular merits) ONR criticality specialist advice must be obtained. However, inspectors may wish to question the licensee about its early design considerations of evacuation routes with respect to conflicting hazards or security demands. | The inspector may wish to seek assistance from an ONR Criticality Safety specialist in making any judgements in this area.  In general, prompt evacuation from the facility is the desired outcome. If the licensee introduces measures that aim to indicate the potential seat of a criticality, these should be clearly apparent and unambiguous to personnel, such that they do not introduce any delay in personnel evacuation. |
| 1. Are there any conflicts between evacuation routes for criticality and marked evacuation routes for other hazards (e.g., fire)? | In some licensee facilities there may be a commonality of evacuation routes e.g., the fire escape route may also be the logical criticality escape route. Where this is sensible and justified then it is not discouraged. However, the licensee should also be able to clearly demonstrate that it has adequately considered any potential conflicts between different evacuation routes e.g., criticality and fire and be able to show that the risks posed by any such conflicts are adequately understood and have been minimised as low as reasonably practicable (ALARP). | The inspector may wish to question the licensee on its philosophy behind the design of the evacuation routes from a facility. ONR Human Factors (HF) input may be necessary in ensuring that the licensee’s chosen evacuation routes design is appropriate and achieves a minimisation of risk to evacuating personnel. |
| 1. For criticality focused emergency exercises conducted by the licensee, is a criticality safety specialist involved in constructing the exercise scenario to ensure it is both realistic and suitably challenging for the Exercise ‘players’? | Licensee Criticality Safety specialists have an important role to play in the design of any licensee criticality safety focused exercise. The key role is ensuring the exercise is both realistic but also challenging for the licensee ‘players’. It is ONR’s expectation that the licensee will make appropriate use of this important resource. | The inspector may wish to sample the planning stage of a criticality exercise and ensure that all appropriate experts are being utilised in the planning to ensure the exercise is both realistic and challenging. |

**Note**: The inspector may wish to sample a criticality focused exercise to see that workers evacuate promptly and are quickly and efficiently processed at the Evacuation Centre to ensure prompt identification of those worker who may have received a significant radiation dose from the criticality incident.

## Criticality Dosimetry

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Are workers in Prompt Evacuation Zones – PEZ and surrounding areas (although not transient workers) equipped with criticality dosimeters or lockets and are these routinely being worn?   [Note - PEZ workers will be those requiring priority dose evaluation]. | All workers in areas where significant quantities of fissile material are stored, handled, or processed should be equipped with (and utilise) dedicated dosimetry to allow prompt evaluation of their likely doses following a criticality event (allowing medical interventions to be focused on those workers revealed to have had a significant radiation exposure). | The inspector should sample that workers in fissile material facilities are wearing their dosimeters/lockets as required. Criticality lockets should be worn outside the clothing, one locket on the front and one locket on the back of a person.  It should be noted that in exceptional circumstances (and when authorised by a Radiological Protection Advisor – RPA) the wearing of criticality belts in a PEZ may not be compulsory e.g., where potential safety risks may be posed by wearing of the belt when workers are accessing scaffolding.  Criticality dosimeters/lockets would be assessed in the event of a criticality incident and the results used to estimate personnel exposures so that due prioritisation can be given by the medical services to the more highly exposed individuals. |
| 1. Does the licensee have Health Physics Monitors and suitable instruments ready for prompt deployment to the Emergency Evacuation Centre to allow initial monitoring of worker’s dosimeters and/or torsos if required (for Sodium-24 activation) and to allow prompt segregation of workers who may have received a significant radiation dose (and who hence may need medical intervention) from those who have received negligible doses? | It is ONR’s expectation that the licensee will have, from studies of likely numbers of personnel evacuating to each Emergency Evacuation Centre, evaluated the numbers and types of instruments it requires to have present at its Emergency Evacuation Centre and can demonstrate that:   * These are present at the Evacuation Centre or can quickly be procured from stocks elsewhere on site, * Adequately trained personnel will be available to operate the instruments, * All instruments are on routine calibration and maintenance schedules and appropriate substitution arrangements are in place when an instrument has to be taken off-line for calibration or maintenance. | The inspector may wish to understand in more detail how the licensee has analysed its instrumentation requirements at its Emergency Evacuation Centres and how these are then managed. Instruments in the Evacuation Centres should be sampled at random to ensure they are within calibration. Advice from an ONR Control and Instrumentation Specialist/RP Specialist may be required when deciding whether the instrument types deployed are fit for purpose. |
| 1. What arrangements does the licensee have with external organisations for monitoring of criticality lockets, blood samples etc. to give more definitive information on the magnitude of actual worker exposures? How quickly can results be obtained?   [Note – some licensees may have their own facilities allowing prompt and detailed locket analysis]. | It is expected that the licensee will have a service level agreement with an approved local laboratory service, capable of analysing criticality lockets and/or blood samples to provide prompt estimates of worker doses from the criticality. In addition, the licensee should be able to demonstrate that it routinely exercises the transfer of such samples to its contracted analytical service and has indicative turn-around times for the analysis results. | The inspector may wish to sample documentation providing evidence that suitable and sufficient arrangements are in place. |
| 1. Does the licensee have appropriate and viable arrangements in place with the local ambulance service to ensure that personnel exposed to high doses can be conveyed promptly to medical facilities where they can receive specialist assessment/treatment? | ONR would expect licensees to work closely with their local ambulance service(s) to provide specialist RP training to ambulance personnel on dealing with contaminated and/or irradiated casualties. It is also an expectation that agreements are in place as to how those casualties will be readied for onward transfer to specialist medical facilities, with a view to minimising doses to medical personnel and/or contamination of vital emergency vehicles. The licensee should be able to demonstrate close working with local ambulance personnel via joint working during/participation in licensee emergency exercises. | The inspector may wish to sample any agreements for casualty transfer that the licensee may have in place with the local ambulance service. |
| 1. Can the licensee produce documentary evidence to demonstrate they have looked at a full range of available options for the processing of criticality lockets, dosimeters, blood samples etc. to give the optimum turn-around of results? | It is expected that the licensee will have reviewed a number of potential suppliers of analytical services, relating to analysis of dosimeters of blood samples to evaluate criticality doses to personnel, based upon a structured series of criteria and will be able to adequately justify the service provider it has chosen. | The inspector may wish to sample the licensee’s optioneering in this area and may wish to probe any choice of provider that due to geographical location potentially provides a slower return of the analysis results. |

## Criticality Emergency Evacuation Centre

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Does the layout of the Emergency Evacuation Centre lend itself to easy segregation of lower dose and potential higher dose personnel and does it allow for segregation of personnel from contact and non-contact areas? | Whilst specific industry guidance is lacking in this area, ONR’s general expectations around Criticality Evacuation Centres (CEC) are:   * The CEC should be a place of safety so that anybody attending the CEC is protected from further criticality dose spikes. * The CEC should have sufficient physical capacity to receive, hold and process all of those personnel that may be affected by the criticality event. * The CEC should have appropriate facilities to hold personnel for protracted periods of time. * Appropriate storage should be available for personnel monitoring equipment, or such equipment should be accessible or readily deliverable to support triage. | Evacuation centres should allow personnel to receive a prompt initial screening (e.g. based on a preliminary interview) to allow personnel who have potentially received a dose from the incident to be segregated from personnel who are unlikely to have been exposed to any significant dose from the incident. This will then permit investigation and medical resources to be targeted promptly and effectively on the higher risk personnel.  Similarly, and in order to limit a potential for a spread of contamination (and hence worker exposure to internal dose), the design of the Evacuation Centre should provide for separate entrances for contact and non-contact workers (that is for worker who may have been exposed to radioactive material to be separated from those, such as office workers in inactive areas, who should not have been exposed to radioactive materials). Within the Evacuation Centre there should also be provision for safe undressing from contact clothing, for new clean clothing to be provided and for the bagging and removal of potentially contaminated clothing. The Evacuation Centre ventilation system should be designed to preclude any potential spread of contamination from the areas accessed by contact workers to areas accessed by non-contact workers. |
| 1. Can a roll-call easily be taken at the Emergency Evacuation Centre? | The Evacuation Centre should have sufficient space to allow lines of personnel to be established to pass through a roll call and/or electronic pass readers should be installed to allow personnel to scan their passes to facilitate the roll call. Ideally the Evacuation Centre should also be equipped with a PA system to assist in the roll call and the making of important announcements. | N/A |
| 1. Is the welfare of the evacuating workers adequately catered for within the Emergency Evacuation Centre e.g., are there sufficient chairs, are toilet facilities available, could workers be given food and drinks if they had to spend an extended period in the Centre? | There is the potential for workers evacuating from a criticality incident to be held at the Emergency Evacuation Centre for some time, as the nature of the incident is investigated, and low and high dose personnel are segregated for potential medical intervention. It is hence important that the licensee has considered the ongoing welfare of its workers during this time period e.g., such factors as:   * The warmth of the workers sheltering during the winter months, or extremes of heat during the summer months, * Keeping workers hydrated (i.e., being able to issue them with hot or cold drinks), * For large numbers of workers that there are an adequate number of toilets, and that consideration has been given to both male, female, and disabled toilet provisions, * That if workers had to be held for prolonged periods of time – that arrangements can be made to bring food in, * Availability of chairs in sufficient numbers to accommodate all personnel likely to evacuate as well as staff manning the Evacuation Centre. | The inspector may wish to visit the Evacuation Centre and from visual inspection form an opinion as to whether the Evacuation Centre has been adequately sized and equipped. The licensee should also be questioned as to what provisions it has made for feeding the occupants in the event of a prolonged period of occupancy being required. |

## Criticality Incident Detection and Alarms

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. As a simple starting point the Inspector may wish to satisfy himself/herself that the ‘clip clop’ sound of the Criticality Warning System (CWS) is easily audible in all plant areas. [It should be noted that the ‘clip-clop’ is a fault diagnostic aid and is not directly related to the criticality alarm broadcast audibility i.e. although in certain locations the audibility of the ‘clip-clop’ may be poor, the criticality alarm itself would be perfectly audible]. | The ‘clip clop’ of the CWS should ideally be clearly audible across any facility handling, storing or processing fissile material (unless a CWS omission argument is in place). However, ONR acknowledge that it may be acceptable for the licensee to demonstrate that there is good audibility in most areas where personnel are located or could be working (i.e., good confidence that a fault condition would be revealed) rather than requiring easy audibility of the ‘clip-clops’ in all plant areas. | It is also usual practice for fissile material facilities to have an audible ‘clip-clop’ sounding constantly at low level, to assure personnel the warning systems are functioning properly. Should the ‘clip clop’ be inaudible then the inspector should seek clarification from the licensee as to why this is the case and obtain a commitment from the licensee to rectify the situation promptly if it is possible to do so.  Failure of the ‘clip-clop’ should be interpreted by the licensee as the CWS being unavailable until the CWS can be demonstrated to be fulfilling its safety function. Accordingly, the inspector may wish to question the licensee as to what measures it takes to restrict fissile material operations until the CWS has been demonstrated to be delivering its safety function. |
| 1. For licensees where criticality warning systems are required, what routine tests are conducted to ensure that criticality alarms continue to be audible throughout facilities where they are installed (particularly in higher noise environments where alternative visual warnings have not been installed)? Are similar routine tests conducted of the criticality incident detection heads? | These tests should be included on the EIMT schedule for the facility with a suitable periodicity for the test being justified by the licensee. Evidence of completion of these scheduled tests should be requested by the inspector, together with the test results and evidence of rectification of any faults identified by such tests. [Note the conduct of the audibility tests will usually involve the deployment of personnel to locations throughout the facility, to report back on audibility across the facility].  It should be noted that if a detector head is inoperable then it does not necessarily mean that the Criticality Warning System (CWS) cannot fulfil its safety function. For example, in a two out of three-detector voting system the alarm would be broadcast on a one out of two basis if one detector were faulty. It is also recognised that some larger facilities have ‘zones’ and the cessation of the ‘clip-clop’ tone in one zone would not necessarily affect the other zones. Accordingly, it may not be necessary to cease fissile material operations due to an inoperable detector head. However, ONR expects that where an audible alarm and/or detector head is found to be inoperable or inaudible, fissile material operations in that part of the facility will be halted until such time as *the* Safety Function of the alarm system is assured. | Alarm audibility tests should be conducted under conditions of maximum background noise levels likely to be encountered in a facility/work area. |
| 1. Is the licensee conducting audibility tests of the criticality alarm itself, across all its fissile material facilities and in all areas of these facilities, with an appropriate and justified periodicity? | ONR expects the licensee to be identifying, from its periodic criticality alarm audibility tests, any plant areas where there are potential problems with criticality alarm audibility. In such plant areas ONR expects that suitable alternative criticality alarm annunciation warning arrangements will be in place i.e. to warn personnel of the occurrence of criticality e.g. flashing beacons in high noise areas - NAWLs, or radios issued to workers accessing remote facility areas where audibility of the alarm may be in question (these suggestions are intended to be indicative only and it is up to the licensee to justify the arrangements chosen to warn personnel in areas where the potential audibility of the criticality alarm is in question). | Licensees should be conducting audibility tests with reference to BS EN 50849:2017 on audibility and should set clear and justified performance requirements for each speaker channel.  In high noise areas where the licensee has installed alternative visual criticality warning devices (e.g., flashing beacons) the inspector may choose to ask to be shown the positioning of the visual alarms and may wish to ensure that these are fully operational.  The inspector may also wish to question the licensee as to the arrangements made for personnel visiting/working in remote plant areas where the criticality alarm may not be audible.  The licensee should also be able to demonstrate that it is cognisant as the needs of any plant personnel who have known hearing difficulties and has made suitable arrangements for such personnel. |
| 1. Can the licensee demonstrate that an appropriate and robust assessment has been undertaken to inform the required number of CWS sensors and that these have been placed in suitable locations and that each of the detectors will adequately respond to the minimum incident of concern? | It is expected that the licensee will be able to provide a formal assessment, using an industry recognised computer code such as MCNP, MCBEND etc. to demonstrate that the current placement of its CWS detectors will detect the minimum incident of concern in a criticality event and also that the licensee will be able to provide a robust justification (in accordance with industry RGP) for its chosen minimum incident of concern. | The inspector may wish to seek advice from ONR Radiation Shielding Experts to seek an informed opinion on the quality of the licensee’s work in this area. |
| 1. What mechanisms are in place to ensure that the location and performance of detectors would be re-evaluated should future modifications be made to the plant/plant layout? | It is an ONR expectation that the licensee will periodically revisit its placement analysis to ensure its detectors remain optimally located and that any change to plant layout, which could potentially shield some of the detectors from the likely seat of the criticality event, would prompt a reassessment of the detector siting via the licensee’s LC 22 processes. | The inspector may wish to check that the use of the licensee’s LC 22 process for plant modifications in fissile material areas would be likely to question whether any re-evaluation of CWS placement will be required. |
| 1. Has the licensee any provisions in place enabling it to remotely access plant gamma monitors, CCTV etc. (to collate information to assist in the location of the criticality incident) within the Emergency Control Centre? | Most fissile material areas are subjected to close security surveillance e.g., via multiple CCTV feeds and the areas are also likely to have multiple radiological instruments (e.g., to warn the workforce about contamination events or high dose rates). Such information could be invaluable when trying to locate the exact location of a criticality event (which in turn could help to quickly identify those workers who may require medical interventions).  Accordingly, and as a matter of good practice the licensee should be encouraged to ensure, so far as is reasonably practicable, that the information provided by such systems can be made remotely available either in an incident management suite or within the Evacuation Centre itself. | It is stressed that the use of on plant CCTV and/or radiological information is not mandated by any current UK standards but since such systems may be in place on licensee plants for security or radiological control purposes, then it may be practicable for the licensee to access some of this information to assist in its criticality response. The inspector may wish to question the licensee as to what information is currently available and as to whether it is reasonably practicable to utilise such information for criticality response purposes.  Note that, should these systems be claimed to support a safety function within the safety case, then their continued ability to support this function during and/or after a criticality needs to be considered by the licensee (e.g., is the CCTV camera damaged in the high radiation field of a criticality)? Do the gamma monitors continue to function at high gamma rates? |
| 1. Even though the licensee may have made a successful CWS omission case, are other radiological instruments in place that would indicate that a criticality had occurred and are arrangements in place to ensure workers would evacuate the immediate area if such radiological instruments were to raise an alarm? | ONR recognises that provision of a full CWS system in fissile material facilities is costly both in installation and ongoing maintenance costs. A CWS omission case will generally seek to show that even with all controls removed, the occurrence of criticality would not reasonably be expected. Nonetheless, it is still prudent to have some means of warning plant personnel of the presence of high dose rate fields; routine gamma monitors, installed for purposes other than criticality warning, may provide a useful tool to ensure workers evacuate those areas. Accordingly, it would be ONR’s expectation that the licensee would have considered what actions it might require workers to take should an unforeseen criticality event trigger such monitors (that is ONR would seek reassurance that the primary response would be to evacuate workers from potential high dose rate areas whilst the cause of the alarms triggering was further investigated). | ONR note that licensees will generally and quite correctly plan for those accidents which are judged to represent the major health and safety threats to the workforce or the public (for example in the criticality source buildings) with an ability to extend these plans ‘at the time’ to cover less likely accidents. A criticality event occurring on a plant with no criticality emergency plan in place would almost certainly reveal itself by high external radiation being detected on a range of installed instrumentation, whose design purpose was not linked to criticality detection. It would then be the plant (and site) management’s role to interpret the unusual (and highly unlikely) event as a possible criticality incident and to instigate an appropriate ‘at time’ response consistent with such an event. |

## Specialist Criticality Support in Event Response

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. In the event of occurrence of a criticality, does the licensee have access to a trained criticality specialist(s) and how quickly could this subject matter expert support reach the Emergency Control Centre to commence the provision of specialist advice to the team responding to the incident? Does this timeframe appear reasonable to the ONR inspector and has it been justified by the licensee? | ONR accept that it would be challenging/unrealistic to expect a single criticality specialist to support an actual criticality incident response. Accordingly, it is acceptable for a licensee to explore other means of providing access to appropriate criticality safety expertise (whether or not the licensee’s fissile material operations are 24 hours). Notwithstanding, ONR expect that the licensee will be able to articulate and justify a credible plan for the provision of timely criticality safety expert advice to the licensee’s emergency response team and to be able to demonstrate that a range of options have been explored to ensure such advice can be accessed as promptly as possible (for example by the use of telephone and/or video conferencing – these suggestions are not intended to be an exhaustive list). | N/A |
| 1. Since criticality excursions have a potential to ‘pulse’ over protracted timeframes, does the licensee have suitable arrangements in place to ensure ongoing criticality safety support over any such extended timeframes? | The licensee should be able to demonstrate that it has considered (optioneered) the provision of specialist response to incidents (including criticality related incidents) over an extended timeframe and has a credible and (ideally) tested plan to deliver this required provision. The licensee should be able to demonstrate that it has sufficient ‘defence in depth’ within its specialist teams to make ongoing delivery of advice credible. | N/A |
| 1. Does the specialist criticality assessor have key information already available at the Emergency Control Centre to assist him/her in the provision of advice to the team responding to the incident? For example, some licensees have developed ‘grab packs’ containing key information/data which the criticality specialist can access, other licensees have developed such packs into quite sophisticated but easy to interpret ‘tool kits’. | ONR would expect key information to be readily available to any criticality safety specialist providing advice at the incident control or Emergency Evacuation Centre (such information might include, but is not limited to, layouts of fissile material facilities, positions of criticality detector heads in those facilities, site layouts, criticality handbook data, criticality dose ‘ready reckoners’ etc.). Such information may be permanently held at the incident response location or may be made available to the responding specialist within a ‘grab pack’. However, any information made available should be subjected to routine and regular review to ensure the most up-to-date information is always provided. The conduct of such reviews should (ideally) be documented, together with any key findings and the actions taken to remedy any shortfalls. | The inspector should review the information made available by the licensee to the specialist criticality assessor but should also take advice from an ONR Criticality Specialist as to the applicability of the information and what if any key information is missing.  Some of the required information may be available electronically (for example plant drawings) but will be accessible from the Emergency Control Centre. ONR note this has advantages in ensuring that the most up to date information is available. |
| 1. Is there evidence that the licensee is actively trying to improve the level of information made available at the Emergency Control Centre to its criticality specialist responder(s)? | There is an ONR expectation that a Review Learn and Improve (RLI) type session be held after each criticality focused exercise and that one of the foci of such exercises should be to seek improvements to the level of information made available in advance to the responding specialist criticality safety assessor. | The inspector may seek evidence of such RLI sessions having been held and the actions emergent from such exercises. |
| 1. Is the licensee actively consulting with other licensees in order to seek improvements to its information provision to its criticality responders at the Emergency Control Centre? | The licensee should be able to demonstrate that its criticality safety assessors are using both their links with the rest of the industry e.g., via the WPC and their more informal working relationships with criticality safety professionals in other licensees, to ensure their criticality emergency information provision matches industry best practice. Licensees should be able to demonstrate that they are learning from one another and ideally should be able to show how the information provision is improving and/or what initiatives are in place to deliver improvements. | N/A |
| 1. Have facilities been allocated in the Emergency Control Centre (or within another suitable facility, potentially away from the Emergency Control Centre itself – see note in final column) to allow the criticality responders to work effectively e.g., a ‘quiet area’ with access to computer databases, plant documents etc. and equipped with communications and conference facilities for discussions with other responders? | Emergency Control Centres, by the very nature of the role they deliver, can quickly become very crowded and noisy places with a constant stream of personnel entering and leaving. In order to make informed decisions/provide sound advice, the criticality specialist(s) will need a quieter area in which to sift available data, make calculations, access information on computers, consult with colleagues etc.  The licensee should be able to demonstrate that ‘quiet areas’ have been allocated, in the immediate vicinity of the main Emergency Control Room (or elsewhere where the licensee judges this to be appropriate), where resources for specialists such as criticality safety assessors have been set aside. The licensee should be able to demonstrate that the criticality assessment team has been fully consulted in the design and layout of such areas and again that design improvements are actioned by taking the learning from exercises. | The inspector may wish to view the ‘quiet area’ facilities available within or remote from the Emergency Control Centre but may also wish to engage with the licensee’s criticality safety professionals to ensure that this team has been consulted in the design of the overall facility and has opportunities to feedback suggestions for facility improvements following criticality focused exercises. Assurance should be obtained by the inspector that any such facilities are adequately equipped with communications, computer resources, desks, welfare arrangements etc.  Note – some licensees may wish to establish the ‘quiet area’ away from the Emergency Control Centre itself where a criticality technical response team can be established. It is recognised that the criticality specialists attending the Emergency Response Centre itself are likely to have coordinating roles and will have multiple demands placed upon them for the provision of advice and will thus have a need to refer to other specialist criticality safety colleagues in a technical cell where safety cases can be examined, calculations conducted etc. in a quieter environment and away from the pressure of the ongoing event response. |
| 1. Does the licensee have any arrangements in place to bring in additional specialist criticality safety advice as required (e.g., from elsewhere within its own organisation, other sites, the Corporate Centre and from other licensee’s organisations) and are these arrangements exercised? | Recognising e.g., from the Tokai Mura experience that a criticality emergency can extend over a protracted time period and that some licensees may have only limited criticality specialist resource to call upon, it is ONR’s expectation that the licensee will have conducted some contingency planning for such a scenario. Ideally, as a matter of good practice, a licensee will be able to demonstrate that it has arrangements in place to draw upon more specialist criticality resource from within its own organisation (should this be available) and/or have sought and obtained agreements with other licensees for their criticality specialists to support the licensee’s response should the emergency prove to be of protracted duration.  However, it is likely that a more realistic position is that the licensee will exercise a more informal (at the time) draw on available additional criticality safety expertise. This position, although not ideal, may be accepted by ONR if a licensee can demonstrate it has at least explored more formal contingency arrangements and justify why these cannot be reasonably implemented.  Should the licensee be able to demonstrate it has contingency arrangements in place, then ONR consider it good practice for the licensee to have exercised any such arrangements and the learning has been reviewed to identify improvements that can be made to the arrangements. In the case of any agreement to use specialist criticality safety personnel from other licensees, evidence should be available that the licensees are working together to ensure specialist criticality personnel, supplying a site experiencing a criticality emergency, have been familiarised with the key fissile material operations on that site (so far as commercial sensitivities and security considerations permit). | The inspector should seek evidence of any reciprocal agreements between licensees being in place, that such arrangements have been exercised and that the exercise outcomes have been subjected to an RLI type exercise. |
| 1. Can the licensee provide evidence that its processes dictate that specialist criticality safety assessor advice is normally sought/obtained in all decisions concerning potential re-entry into the source building e.g., for event termination, casualty recovery and that re-entry in the absence of such specialist criticality safety advice would only normally be sanctioned by the Emergency Control Centre decision maker in exceptional circumstances? | Recognising that criticality events for some fissile systems have a potential to have multiple ‘spikes’, which can cause high radiation doses to exposed personnel, it is important that a robust and adequate risk assessment is in place before additional resources are committed to re-entry of the area where the initial criticality has occurred. Such a risk assessment could not be regarded as being complete without specialist criticality safety assessment input (based upon all the information known at the time). The licensee should have systems in place that require the provision of such advice before any building re-entry can be sanctioned.  ONR, however, accept that in exceptional and dire circumstances (e.g., to avoid a major off-site release) the Emergency Control Centre decision maker may have to sanction re-entry if specialist criticality safety advice is not immediately available. ONR would expect any such decision would be recorded in the Emergency Control Centre logs. ONR expects that any such decision would be considered on its merits during post-event analysis. | The inspector should sample the licensee’s decision-making process for building re-entry following a criticality event. |

## Event Termination

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. The licensee should be able to demonstrate it has considered event termination in its emergency planning e.g., as to how it might realistically terminate a criticality event and what supplies (e.g., of neutron poisons) if required it has procured and stored on its site(s) to facilitate such shut-down operations? | The licensee should be able to provide evidence that an exercise has been carried out for each of its facilities storing, handling, or processing significant quantities of fissile material, which should have considered the credible nature of the event and how the event may terminate. If self-termination is unlikely and the event has a potential to ‘spike’ then the licensee should be able to demonstrate that it has considered what measures it might need to take to terminate the event and what resources (e.g., neutron poisons) it might need to do this. Where specific equipment or chemicals have been identified as being required to terminate the postulated event, the licensee should be able to provide evidence that it has procured stocks of such equipment/chemicals and that these are stored on or very close to site (as per manufacturer’s guidance) for rapid deployment should such an emergency event occur. In addition, the licensee should be able to demonstrate that routine inspections and/or maintenance (if required) of the stock of equipment/chemicals is undertaken and that any problems identified are promptly rectified. | The inspector may wish to sample any assessment work the licensee has conducted in this area. Where equipment/chemicals have been identified as being required for event termination, the inspector may wish to sample the licensee’s store of such chemicals/equipment. |

## Exercising of Arrangements

| Question | ONR Expectations | Additional Comments |
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| 1. With what frequency does the licensee conduct criticality focussed exercises to test its response arrangements and how are such exercises assessed? | The licensee should be able to justify how it has judged the periodicity with which it undertakes criticality safety focused exercises and should ideally have compared this with the periodicity with which other licensees conduct similar exercises (to ensure that, given the licensee’s specific risk of occurrence of criticality, it is not grossly out of step with the rest of industry). The licensee should have systems in place to ensure the holding of such exercises is adequately planned and take place to the licensee’s defined exercise plan. The licensee should also be able to demonstrate that adequate RLI exercises are conducted at the conclusion of exercises, that appropriate actions are placed where improvements are required, that these actions are tracked to completion and that the improvements are then tested during the next exercise. | The inspector may wish to sample how the licensee has defined its criticality exercise periodicity and confirm that the conduct of exercises is tracked to ensure this periodicity is met. The inspector may also wish to sample the outputs from post-exercise RLI sessions and track actions from such RLIs through to completion. |
| 1. Does the licensee routinely observe the different key ‘players’ in a criticality exercise to obtain any learning from these? | The licensee should position criticality safety specialists as observers at those positions key to criticality safety, in order to observe the mechanics of personnel responding in a criticality emergency. For example, criticality safety personnel should be deployed at the first muster point for frontline workers (who are likely to have been affected by the criticality incident), where these personnel first describe the operations, they were undertaking. Doing so will aid the criticality safety specialists to better understand the conditions under which the workers evacuate (e.g., how does the muster taker elicit key information from evacuating workers and what time pressures are they under, how is the information interrogated and distributed and how is it used to aid decision making on casualty prioritisation?). | Observing such positions during exercises can help the criticality safety specialist better understand the conditions personnel experience during emergency response, and whether they appreciate the importance of relaying key pieces of information through the communication channels to the criticality safety specialists in the Emergency Control Centre. Feedback from the criticality specialist observers should also assist the licensee in making improvements in this area of information gathering and dissemination. |

# Appendix 6 – Licence Condition 19: Construction or Installation of New Plant

New plant design can pose some unique challenges for criticality safety, where there can often be competing safety and plant throughput requirements. It is imperative however that criticality safety is an integral part of the overall design process, and that criticality safety is not considered as a ‘bolt on’ at the end of the design process. Accordingly, the criticality assessor should be an integral part of the overall plant design team.

When inspecting criticality safety aspects of new plant/equipment design and build, the ONR inspector may wish to consider some of the following questions.

| Question | ONR Expectations | Additional Comments |
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| 1. Can the licensee demonstrate that criticality safety advice has been sought and obtained from the very earliest stages of inception of the project (e.g., did criticality safety professionals participate in the optioneering stages of the plant/equipment design)? | Documented evidence should be available to the ONR inspector for sampling, allowing the inspector to judge the project stage at which specialist criticality safety advice was sought and obtained.  Ideally the license should be able to demonstrate that criticality safety specialists have been allocated to the project from its inception and these individuals have been fully integrated into the overall project team (the licensee may even have co-located such specialists with the main design team). | Examples of evidence could include things such as meeting minutes, meeting attendance records, document sign-offs, etc. which demonstrate criticality safety specialist involvement. |
| 1. The licensee should be able to demonstrate that its optioneering provides assurance that a broad range of options has been considered by a full range of stakeholders. In conducting such work, the licensee should provide assurance that it has balanced all risks (i.e., not just criticality) and has recognised that some risks may be more dominant than the criticality safety risk. | Documented evidence should be available for the ONR inspector to sample allowing a judgement to be reached as to whether all hazards/risks have been considered by the licensee and that consideration of all hazards/risks has had support from a full range of relevant specialists. | Examples of evidence could include things such as meeting minutes, meeting attendance records, document sign-off, copies of optioneering documents etc. A range of documents should be sampled in reaching a judgement as to whether the licensee has successfully demonstrated that a full range of possible options has been studied, along with their associated risks/hazards, by a range of relevant safety specialists in reaching a choice of option(s) to take forward to detailed design.  It may be necessary for the inspector to involve other ONR specialists to determine that all risks and hazards have received due consideration by the licensee. |
| 1. The inspector should seek to identify any situations where criticality safety considerations during plant/process design may have driven a non-optimised balance of overall risk e.g., where a solution implemented to reduce the risk of criticality has potentially increased risks within another area. [Such examples are useful for future ONR guidance]. | ONR expect a judgement to be made by the licensee regarding the balance of risk. The overall risk presented should be reduced ALARP. Advice from other ONR specialists should be sought when making judgements, based upon the licensee’s presented evidence, as to whether a suitable balance of risk across the licensee’s chosen design, has been achieved by the licensee. | Where there are examples of the risk in other areas being ‘skewed’ by design provisions necessary for criticality safety, then the ONR inspector should communicate such examples to the ONR Professional Lead for Radiological Protection and Criticality (RP&C) so that consideration can be given to incorporating the learning into relevant ONR guidance. |
| 1. Has the licensee adequately considered how its new plant/process will interface with upstream/downstream plants and has due consideration been given to the criticality safety considerations at those interfaces? Consideration should also have been given to any criticality safety impacts upon transport and future waste disposal (the licensee should be cognisant of the requirements of the joint regulator’s guidance on ‘Geological Disposal’ provided in ONR Technical Assessment Guide, TAG, NS-TAST-GD-101 and with “The Management of Higher Activity Radioactive Waste on Nuclear Licensed Sites. Joint Guidance from ONR, EA, SEPA and NRW to Nuclear Licensees.” Revision 2, 2015.   It is noted that the Joint Regulator’s Guidance document referred to above include transport to the Geological Disposal Facility, GDF, and is important as criticality issues must be avoided during transport to all disposal sites (not just the GDF) and notes the current push to dispose of ILW at surface or near surface sites (but accepting the inventory differences – c.f. the GDF). | Arrangements for the construction and installation of a new plant at an existing installation shall address the impact upon, and the continued validity of, that installation’s safety case.  Where the construction or installation of a new plant at an existing installation impacts upon the extant safety case the licensee shall use its arrangements under LC 22 to manage that impact.  The licensee shall also be able to provide documentary evidence that it has considered all existing down-stream and up-stream plants that any new facility/modification to an existing facility may impact upon. For each plant potentially impacted then studies should be available that demonstrate impacts across a range of technical disciplines (including the safety case) have been adequately explored and any required mitigating measures and/or safety case update work has been identified. As a part of any safety case impact work, criticality safety specialist advice should have been obtained as to whether the impacts pose any new criticality safety challenges. The licensee should be able to demonstrate that appropriate work streams have been specified to address all identified impacts (including the safety case and criticality safety case). | The inspector should sample the licensee’s work in this area and seek advice from a range of appropriate ONR specialists in judging the thoroughness/robustness of the licensee’s work. The inspector may wish to sample any ongoing licensee work in this area to ensure it is adequately tracked to completion. |
| 1. Given that most members of the project design team are likely to have little or no knowledge of the basics of criticality safety, can the licensee demonstrate that training has been delivered at the earliest stage of the project to raise the level of criticality safety awareness across all the design disciplines (and if required across plant/equipment vendor personnel)? | Focused training of the design team should be delivered at as early a stage of the project as is realistic/useful (e.g., when the main design team has formed, is relatively stable in terms of personnel and has commenced its optioneering work) by an accredited criticality safety specialist. The training would be expected to cover both the basics of criticality safety (e.g., the key factors affecting criticality) but also key aspects of a design that can affect criticality safety e.g., pipe and vessel sizes and fissile material control and tracking systems. Potential accumulation sites for fissile material should also be discussed e.g., valves, sumps, filters, traps, and ventilation ducting (here reference should be made to problems encountered in existing plant globally). Understanding of the information should ideally be tested and arrangements for training of new personnel joining the design team should be made. For design work conducted over protracted periods, it may also be necessary to have arrangements for refresher training to be delivered. | The inspector, with advice from an ONR criticality safety specialist, may wish to sample the quality of the training material to ensure it is appropriately focused for its target audience. It may also be instructive to challenge members of the licensee’s design team to ensure the team has ready access to criticality safety advice, i.e. that the team knows who the criticality safety specialists are, can confirm that these persons attend all key design meetings and can confirm they spend an appropriate amount of time in the project offices. |
| 1. Are the criticality safety professionals, assigned to the design team, continuing to reinforce the criticality awareness of the design team members e.g., by good clear communications across the design team? | Documented evidence should be available to the ONR inspector to sample in determining whether effective communications between design team members and criticality safety specialists has and is continuing to take place. | Examples of evidence could include things such as meeting minutes, meeting attendance records, document sign-offs, etc. which demonstrate that criticality safety specialists have been continuing to communicate with the design team. The licensee may also be able to demonstrate that criticality safety specialists give ad-hoc ‘toolbox’ talks on criticality safety topics to the design team. |
| 1. Is a clear and well documented record being maintained of all key design decisions, including those made with respect to criticality safety? | It is expected that all key design decisions will have associated records which should provide a justification for that design decision, the options that were considered in choosing that particular option and the reason why other options were rejected (especially if they could potentially have resulted in a reduction of risk). Such records should be maintained and be readily accessible over the lifetime of the design process. The licensee should be able to demonstrate that all risks across the design (including criticality safety considerations) have been appropriately balanced to give an overall design across all risks and hazards that meets the ALARP principle. | The inspector may wish to sample the licensee’s records of key design decisions, which should include justifications of material inputs and outputs, human interactions with the process and the needs associated with this, equipment design etc. – the list is not intended to be exhaustive. The inspector may wish to seek additional ONR specialist input in making a judgement based on the evidence sampled.  There are generally always additional measures that can be taken to reduce the criticality safety risk (e.g., use could be made of fixed or soluble neutron poisons, assay equipment or neutron monitoring which could be deployed at key steps of the process) but consideration of the time, trouble and cost of implementation of such measures must be weighed against the reduction in risk they offer, and an overall benefit found. |
| 1. Are all key design assumptions clearly recorded and tracked and are they accessible to the entire design team? | The key design assumptions should be clearly and robustly argued and supported by suitable and sufficient evidence, readily available for inspection. | N/A |
| 1. Where process controls have been specified by the criticality assessor(s), can the licensee adequately demonstrate that the implied design requirements in such controls have been adequately considered and that the controls and their intent can be accommodated by the design? | As previously noted, ONR’s expectation for the overall design process is of a fully integrated and well-functioning design team with appropriate specialists providing input to the design process. There should be a robust challenge process, across all disciplines, to all proposals for process controls etc. Where specialist proposals have been rejected, the licensee should be able to evidence clear discussion(s) of the proposal and provide sound well-reasoned and documented arguments as to why any such proposals were rejected. | The inspector should seek to sample whether sound evidence exists to demonstrate that the proposed criticality controls have been thoroughly discussed with the other design disciplines and that any problem areas have been resolved. |
| 1. How does the overall design team communicate e.g., is the full design team co-located and has the licensee considered how team bonding could be best effected? | Co-location of design team is advantageous. Regular ‘keep-in-touch’ meetings, team meetings, and specialist meetings can aid effective communications. The licensee should be able to provide evidence that the specialist disciplines are an integral part of the design team and that key design decisions have the joint ownership of the entire design team. | The team effort needs constant and good communication. It must be recognised that words can have different interpretations between different design disciplines and hence testing of understanding across the design disciplines is of importance. |
| 1. Is the licensee employing conservative assumptions in its criticality analysis work? | The licensee should document and justify, along with the other key design decisions, all of the key assumptions it will use throughout the evolution of the criticality safety case. These should, unless robustly justified otherwise, reflect industry RGP or international standards. | The inspector may wish to seek advice from an ONR criticality safety specialist in reviewing the key assumptions the licensee is utilising in making its criticality safety case.  Conservative criticality safety decision making is likely to encompass such topics as: fissile material enrichment assumptions, solutions being modelled at optimum concentrations, reflectors assumed to be infinitely thick etc. Where there has been any deviation from such demonstrably conservative assumptions, there should be a documented justification for the deviation. |
| 1. In the design process, can the licensee demonstrate it is drawing upon lessons learnt from other similar process plant within the licensee’s company, or from elsewhere in the world? | It is important, in ensuring an optimised design that minimises risks and hazards ALARP, that appropriate learning is taken from the design and/or operation of other similar plants/processes globally i.e., either within the UK or elsewhere in the world, not necessarily just from the nuclear industry. Hence it is an expectation that the licensee’s design team will have sought support and/or learning from operators/designers of similar facilities/processes, in the evolution of their plant designs and that key learning will have been utilised in informing design changes/improvements.  With respect to criticality safety aspects of the plant design, national and international seminars, conferences and working groups (e.g. WPC and the International Conference on Nuclear Criticality Safety - ICNC) should also be used to acquire learning/experience with respect to criticality safety aspects of the plant.  The licensee should be able to demonstrate via documentary evidence, that it has actively sought (and where applicable used) learning from other plant operators/designers in optimising the overall design of its plant – including with respect to the plant’s criticality safety case. | The inspector should seek evidence that appropriate learning from experience, both within the UK and internationally, is being sought and applied by the licensee from the earliest stages of the design. |
| 1. Have reasonably practicable criticality safety control features been engineered into the plant (e.g., piping systems should be sloped and drained, gloveboxes should by design ensure that there are no locations hidden from the operator where material could accumulate, consideration should be given to the use of ‘favourable geometry’ vessels and ventilation systems should be designed to preclude any potential for accumulations of fissile material)? Have human factors aspects of the design, where these impact upon criticality safety, also been considered e.g., do the ergonomics of the plant (e.g., gloveboxes) facilitate easy operator access to the process tasks they will be expected to undertake, can plant and equipment be accessed for inspection and clean-out and is instrumentation to be installed to detect any accumulations of solids in the base of vessels? – [This list is not intended to be exhaustive]. | The licensee should be able to demonstrate that it has internal guidance/procedures relating to criticality safety aspects of the design of fissile material facilities and that the guidance provides sound advice to its assessors on the types of key criticality control features they should be seeking to influence (so far as is reasonably practicable) within the plant design.  The licensee should also be able to demonstrate that these criticality design principles are being adhered to within the plant design or provide documented evidence/justification as to why there has been any deviation from these principles. | The inspector may wish to sample the licensee’s criticality design guidance and/or examples of deviations from such guidance. Assistance may be required from an ONR criticality safety specialist. |
| 1. Where neutron absorbing structures are to be used for criticality safety control in plant vessels has the design catered for periodic inspection to allow any degradation of the structures over time to be identified and addressed? | If neutron absorbing structures are defined as safety measures, then they must be included on the EIMT schedule for the plant. The specified EIMT activity should be suitable and sufficient to confirm that the structures continue to deliver their designated safety function and that any degradation is identified by the EIMT activity in a timely manner. In addition, the periodicity of the inspection should have a clear justification that has been documented by the licensee.  Alternatively, the licensee may choose to revisit its safety case in order to demonstrate that the criticality safety control measure is no longer required and that its removal from the safety case still continues to provide for sufficient defence in depth. ONR is likely to wish to sample any such justification for removal of current safety measures designed to maintain criticality safety. | The inspector may wish to sample both the licensee’s justification of the specified EIMT activity and its periodicity.  Neutron absorbing structures may be subject to corrosive conditions (e.g., acids and long-term storage in water) such that their ability to deliver their safety function degrades over their lifetime. The specified EIMT activity must demonstrably be capable of identifying any such degradation in a timely manner.  Liquid neutron absorbing materials may also degrade in service, such that their ability to deliver their intended safety function is impeded. Accordingly, periodic sampling and analysis should be undertaken of any such liquid neutron poisons.  Neutron absorbers (structures/liquids) may also be challenged in a fault condition, leading to a potential criticality hazard. Accordingly, EIMT identified in the Fault Schedule should provide assurance that the design safety function of the neutron absorbers is not compromised by faults they are meant to protect against. |

# Appendix 7 – Licence Condition 22: Modification or Experiment on Existing Plant

| Question | ONR Expectations | Additional Comments |
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| 1. Does the licensee have an adequate process in place to ensure timely consultation with a SQEP criticality assessor for any modification which has a potential to affect criticality safety? How does the licensee document and record the outcomes of all such consultations? | The licensee’s LC 22 process should include adequate prompts requiring SQEP criticality safety advice to be sought when a modification is proposed which changes the plant or process in such a way (including plant documents, drawings etc.) as to impact upon the scope of a criticality safety case or to affect the safety function of a safety designation.  If there is any doubt as to whether any given modification might impact criticality safety, then it is ONR’s expectation that the licensee’s arrangements will establish that the default position is that a SQEP criticality assessor be consulted.  Ideally and as a matter of good practice, a SQEP criticality assessor should sit on the licensee’s change panels for all of the licensee’s fissile material facilities (although ONR recognise this is unlikely to be possible for larger licensees with a substantial number of fissile facilities).  Where the licensee may have a route in its LC 22 arrangements for taking decisions ‘ex-committee’ the licensee should have safeguards in place to ensure the requirement for expert criticality safety advice cannot be by-passed. All discussions at licensee LC 22 committees should be fully documented together with any decisions taken. Sign on to such decisions by appropriate subject matter experts should be demonstrable in the licensee’s records. | The ONR inspector should seek to understand the licensee’s LC 22 arrangements/process and satisfy themselves that due consultation is required by the process with a SQEP criticality safety assessor for any modification with a potential to impact criticality safety.  The inspector should also seek to understand if there are any circumstances in which the licensee’s formal LC 22 process could be by-passed and how the licensee ensures that there is due consultation with a SQEP criticality safety assessor in such circumstances.  The quorate membership of the licensee’s LC 22 committee(s) should be sampled to ensure that appropriate representation is required from a SQEP criticality assessor or that the process clearly flags the need to consult with such a subject matter expert for those modifications with a potential to impact criticality safety.  Minutes should be available from all LC 22 meetings and should be sampled for the quality of the discussions/challenges and the clarity of any actions placed. Where possible a sample should be taken of actions to track these through the licensee’s systems to closure. Wherever decisions are made by the LC 22 committee members, these should be clearly recorded and sign on by the membership should be clear. |
| 1. How is it ensured that the advice provided by the criticality assessor has been incorporated in any plant modification identified as having a potential to impact criticality safety, or that appropriate justification has been provided as to why the implementation of the advice is not practicable but how nonetheless criticality safety is maintained for the modification? | ONR expects that the recording of any criticality advice, pertaining to a proposed modification, will be adequate but commensurate with the extent of the modification proposed and the degree to which the modification has a potential to affect criticality safety. The licensee’s Minutes from its LC 22 committee meetings should reflect any criticality safety advice provided.  When documenting criticality safety advice, provided in consideration of a proposed modification, it should be demonstrated that the SQEP criticality safety assessor has considered both the proposed intent of the modification and the potential consequences if the modification is ill-conceived or ill-implemented. Appropriate mitigations should demonstrably be in place against such occurrences.  During the actual conduct of any modification (previously identified as having a potential to impact criticality safety) and upon its completion, the licensee should be able to demonstrate, where required, an ongoing dialogue with the SQEP criticality assessor. For any modifications deemed to have a potentially significant impact on criticality safety then ONR considers it to be good practice for the licensee to demonstrate that upon completion of the modification, the modification has been signed off as ‘fulfilling its design intent’ by all relevant subject matter experts (including the criticality safety assessor). | The ONR inspector may wish to sample the licensee’s records for completed (or in progress) modifications in order to satisfy themselves that there is clear ‘line of sight’ from the advice/assessment provided by the SQEP criticality safety assessor to delivery of the proposed modification and ultimate sign off by a SQEP assessor in the case of any modification deemed to have a potential to significantly impact criticality safety. Checks should be made that all requirements of the criticality safety assessment of the modification (e.g., limits and conditions) have been accurately translated into the plant documentation (including, but not limited to, the operating instructions and plant drawings). |
| 1. Has the licensee adequately documented all modifications to a facility with a potential to impact criticality safety and does a safety submission support each such modification? | All modifications to fissile material plant with a potential to impact criticality safety should have an accompanying criticality safety assessment (of a rigour to be justified by the licensee i.e. simple modifications may only merit a short memorandum, whilst more complex modifications may merit a more in-depth analysis), or a written justification within the licensee’s records (signed onto by a SQEP criticality safety professional) as to why no such assessment is required. For the most complex modifications, a number of separate criticality safety assessments may be required as the project proceeds through a number of stages. | The ONR inspector should seek to sample the licensee’s list of plant modifications with a potential to impact criticality safety and to take some random samples from the list to ascertain what criticality safety assessment accompanied the modification. Advice should be sought from an ONR criticality specialist as to whether the degree of criticality safety analysis applied to a particular modification is justified and reasonable. The quality of the licensee’s LC 22 documentation should be sampled along with the accompanying criticality assessment. |
| 1. Are any modifications to the plant with a potential to affect criticality safety accurately reflected in the extant plant drawings and the on-plant criticality safety documentation etc.? | Plant modifications may result in an accompanying requirement to update plant documentation e.g., work instructions, maintenance schedules, plant drawings and the plant safety case (the list is not intended to be definitive). In the case of the plant’s criticality safety controls, the modification may require that a new criticality safety assessment be produced along with accompanying criticality clearance certificates/point of work instructions. The plant modification cannot be considered to be fully completed until all required changes to plant documentation have been made and signed off (as required by the licensee’s due process). | It is suggested that the inspector follow through a sample modification from the criticality assessment to the on-plant documentation, but also confirms (ideally via sampling) that plant drawings have been accurately updated (if required).  Where documentation, drawings etc. are still in the licensee’s due process, but use is being made of the modification, the licensee should be asked to justify that the risks posed by such a position have been reduced ALARP. What interim measures have been implemented and what due process was followed? |
| 1. Can the licensee demonstrate where necessary that a new criticality safety assessment has been performed and that any changes to plant operating limits etc. have been accurately translated into the extant plant documentation? Can the licensee demonstrate adequate training has been delivered to the plant operators on the changes? | As noted previously, the conduct of a criticality safety assessment for a plant modification will generally result in new limits and conditions applicable post modification and these should be accurately translated into the on-plant documentation e.g., CCCs/point of work instructions. However, the implementation of new plant documentation (and especially any new limits and conditions related to the maintenance of criticality safety for the plant/process) also may have associated training requirements. The expectation is that the licensee will be able to describe how this required training has been delivered to its on-plant operations personnel, supervisors, managers etc. will be able to provide evidence that the personnel requiring the training have been identified and will be able to demonstrate that the training delivery has been satisfactorily completed. The training will generally depend upon the complexity of the modification undertaken; simple modifications may only require a simple staff briefing whilst more complex modifications may necessitate more in-depth training. As evidence of training delivery, as a minimum, the licensee should be able to demonstrate that staff have signed off to say they have received and understood the training provided. However, where the training delivered has been in more depth then some testing (examination) of the training with a defined pass mark may be appropriate. | Training provision at the completion of a plant modification should be sampled by the inspector; ideally a number of modifications should be chosen to get a view on training delivery for modifications of varying complexity. The inspector may wish to seek specialist advice on the training design, delivery, testing etc. from an ONR human factors specialist. They may also wish to seek advice from an ONR criticality safety specialist to seek reassurance that the training delivered has captured the key requirements of the criticality safety assessment supporting the modification conducted. |
| 1. If new criticality rules/operating conditions are introduced onto a plant or process, how does the licensee ensure that the new rules are being observed and that ‘work arounds’ are not developing? | Whilst new criticality safety related limits and conditions may well have resulted from the plant modification, it is recognised that after a period of operating against the new limits and conditions, problems with compliance may arise. This could occur even if the licensee’s criticality safety assessor has consulted closely with plant management/operators etc. in drafting the new limits and conditions (i.e., to ensure they are fully and easily understood and complied with by the plant operators).  This can sometimes result in plant personnel coming up with their own ‘work-arounds’ (which have a potential to compromise criticality safety in the extreme or at least to degrade criticality safety margins).  Recognising this potential problem, it is ONR’s expectation that for a period after implementation of new limits and conditions, SQEP criticality safety personnel will seek to routinely engage with plant operators to quickly identify any compliance problems and to seek mutually agreeable solutions to such problems (which may result in some re-authoring of the on-plant criticality safety documentation). The results of such on-plant discussions with the operators should ideally be documented by the licensee and any compliance problems identified should be flagged within the licensee’s Abnormal Event (or similar system) reporting process. A clear route to satisfactory resolution of any compliance issues should be available and evidence should be provided that this has been agreed by the SQEP criticality safety assessor. | The inspector should engage with the licensee at both the working level and management levels, as well as the licensee’s criticality safety assessment team, to understand how the licensee monitors the ‘bedding in’ of new criticality safety assessments (e.g. those following a plant modification) and how any compliance problems would be promptly identified, reported and dealt with. Clear consultation with the licensee’s criticality safety assessment team in this process should be evidenced.  In the case of some licensees, it is recognised that the role of ensuring that the new safety case has adequately ‘bedded in’ could be fulfilled initially by a plant-based safety case team and not necessarily the licensee’s criticality safety professionals. |
| 1. In any case where it is planned to restart a plant/process that contains fissile material, after a long period of lay-off/shut-down, how has the licensee satisfied itself as to the fissile material dispositions in the plant/process and has due consideration been given to the potential for fissile material to have migrated/settled? The licensee should be able to demonstrate that it has undertaken adequate checks/inspections of the plant conditions and can accurately account for the location of all residual fissile material. | Following a plant shut-down with residual fissile material remaining in the plant, the licensee should be able to demonstrate that it has documented robust and extensive checks in place to fully understand the disposition of fissile material in the plant prior to restarting the plant. Checks to be conducted may include (the list is not intended to be exhaustive):   * Neutron assay measurements/surveying of the plant, * Sampling (e.g., of residual liquors), * Remote inspections inside process pipework, vessels, sumps, drains etc. – e.g., using fibre optic cameras, * X-ray or gamma ray radiographs of vessels etc. – e.g., to look for the presence of settled solids, * Radiation surveys of ventilation ductwork, * Etc.   It is expected that a number of diverse methods will be used to establish, so far as is reasonably practicable, as accurate a picture as possible of the fissile material dispositions within the plant. The pre-start-up work conducted should also aim to try to quantify the masses of fissile material held at the different plant locations.  Once the plant surveying has been conducted and the results interpreted by the licensee’s subject matter experts, it is anticipated that detailed discussions will be conducted with SQEP members of the licensee’s criticality team (noting that an explicit criticality safety assessment may be required), to seek advice as to the risks associated with plant restart (given the survey information) and any mitigating measures required before starting up can safely be undertaken. | The ONR inspector should seek to understand the measures the licensee takes in re-starting a fissile material plant after a period of shut-down and should seek to compare these against ONR’s expectations highlighted within the previous column. Documentary evidence should then be sought of the conduct of the licensee’s checks from a sample plant restart. It is likely that the ONR inspector will wish to obtain advice from other relevant ONR specialists in forming judgements from the sampling undertaken in this area. |
| 1. Has the licensee a robust process in place for reviewing all work requests to ensure that any errors in the work request likely to have a bearing on criticality safety are identified and resolved in advance of conduct of the work? | Any planned or reactive work on the licensee’s fissile material plant with a potential to challenge criticality safety should be subject to a defined and documented process (e.g., the licensee’s LC 22 process) which flags a requirement (where relevant) for SQEP criticality safety assessor input prior to the work proceeding. All such advice should be documented and if required should result in a dedicated criticality safety assessment for the work. | The inspector should seek evidence of the systems in place in this area and then should seek to test the robustness of such systems via sampling. |
| 1. What aspects of commissioning of a modification will demonstrate that the required criticality safety controls are being delivered and will a SQEP criticality assessor be involved in interrogating the data obtained from the commissioning? | It is important, particularly with more complex modifications where the modification is the subject of a dedicated criticality safety assessment that the SQEP criticality assessor remains engaged with the modification throughout its history i.e., from inception to final delivery. | The ONR inspector should seek information from the licensee as to how the SQEP criticality assessor is involved in the commissioning of a modification and what signatures are required in order to ‘sign off’ a completed modification. |
| 1. From the commissioning data does the SQEP criticality assessor verify it demonstrates that the required criticality safety controls are in place and are functioning as required? | At the conclusion of the modification, the SQEP assessor should be closely involved with commissioning of the modification i.e., to ensure that the key requirements of the criticality safety assessment are met, and that the modification has been accurately delivered as envisaged, with no deviations which might negatively impact upon criticality safety. It is anticipated that the SQEP criticality safety assessors will be one of the required signatories to ‘sign off’ the modification as having been completed and successfully commissioned. | The process should have been documented by the licensee. The inspector should then test that the licensee’s process is being applied accurately by sampling the commissioning of a number of recent modifications. |
| 1. Where any instrumentation/control device(s) are being modified on a plant where the modification has been identified as having a potential to impact upon criticality safety, can the licensee demonstrate it has requested, received and acted upon expert advice to ensure that the modification cannot adversely impact upon any claimed criticality control functions? | Where any modification is being conducted on the licensee’s plant (including modifications to instrumentation or control devices etc.), the expectation is that all such modifications will be controlled via a robust and well documented LC 22 process and that this process will, where the modification has a potential to impact upon criticality safety, flag and require a need for consultation with a SQEP criticality safety assessor for all such modifications.  Where modifications are being carried out by a contractor on the licensee’s behalf, the licensee should be able to demonstrate an adequate level of oversight of the contractor throughout the conduct of the modification, to ensure the work fully meets the requirements/scope of the modification as presented to an agreed by the licensee’s LC 22 process. | As noted previously, the ONR inspector should test the licensee’s LC 22 process to ensure that adequate engagement with subject matter experts (including criticality safety SQEPs) is required, where relevant, by the process. A number of recent fissile plant modifications, with a potential to impact criticality safety, should then be sampled to ensure compliance with the LC 22 arrangements. |

# Appendix 8 – Licence Condition 23: Operating Rules

In the bullets below there are references to both Criticality Clearance Certificates and the Criticality Stations. It is recognised that not all licensees may be familiar with such terms and hence to clarify:

* Criticality Clearance Certificate (CCC) is the distillation of the key criticality related requirements from the criticality safety assessment e.g., moderator and fissile mass limits for a process and/or workstation. These will often be presented in a single document (e.g., the CCC) but alternatively may be reflected/reported in the ‘point of work’ documents for that particular process or work-station e.g., the Operating Instructions.
* Criticality Station – defines the boundaries of a process or work-station to which the criticality limits, as defined from the criticality safety assessment, apply.

**Note**: the phrase “point of work instruction” also appears below and is intended to refer solely to work instructions pertaining to the maintenance of criticality safety.

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. How does the licensee ensure that the limits/conditions, derived from the criticality safety assessments conducted for their fissile material operations, are accurately translated into the plant operating instructions e.g., Criticality Clearance Certificates (CCCs)/point of work instructions? | The licensee should show evidence that a criticality safety professional has reviewed the CCCs/point of work instructions for accuracy and subsequently signed them off and that the CCCs/point of work instructions refer to the current criticality safety assessment from which the limits and conditions have been drawn. Criticality operating rules derived from the safety assessments should be worded in a similar way to those in the rest of the safety assessment and it should be ensured that the wording will be readily understandable by an operator etc. Instructions derived from the criticality operating rules should be checked by a criticality SQEP to ensure that they meet the intent of the operating rules and that they facilitate understanding and adherence. The licensee should be able to provide evidence of audits/inspections of CCCs/point of work instructions against their parent criticality safety assessments. | It is important when translating limits and conditions from criticality safety assessments into on-plant CCCs/point of work instructions that checks are made of the numbers, units, and wording of each of the limits and conditions, ensuring that they precisely match those in the original criticality safety assessment. Criticality control involves interplay of a number of factors and a subtle difference in wording (in either the operating rules or the operating instructions) may result in a very different application on plant to what was assumed/intended in the assessment. |
| 1. Are the CCCs/point of work instructions authored by a trained SQEP who is authorised to do so by the licensee.? Can the licensee demonstrate that personnel appointed to such roles adequately understand the process to which the CCCs/point of work instructions apply and what aspects of the safety assessment must be accurately reflected on the CCCs/point of work instructions? | The licensee should be able to demonstrate that the author (and reviewers/approvers of the CCCs/point of work instructions) are considered by the organisation to be SQEP (i.e. be able to demonstrate their training, assessment and appointment to their current role(s)) and the licensee should provide evidence that the individuals have been authorised by the licensee to author/review/approve CCCs/point of work instructions.  The licensee should also be able to evidence the understanding/experience of the authors/reviewers/approvers with respect to the process covered by the safety case under consideration.  ONR considers it to be good practice for the licensee to periodically review its appointed authors/reviewers/approvers i.e., to ensure that they remain SQEP for these duties, since protracted periods of absence from the conduct of such duties may necessitate an element of re-training. The licensee should be able to demonstrate it has such processes in place and that these are used at a suitable periodicity (determined and justified by the licensee). | Evidence of individuals’ SQEP status and the process by which the licensee trains and maintains SQEP individuals, can be explored in conjunction with other Licence Conditions (e.g., 10, 12). The CCC/point of work instruction limits and conditions should be authored by a SQEP author (not necessarily a criticality SQEP), to ensure that they accurately reflect those of the associated criticality safety assessment. |
| 1. What quality assurance does the licensee give to its production of CCCs/point of work instructions (the inspector should take a view as to how rigorous this process is)? | The licensee should be able to provide evidence of a thorough and established QA process; with a peer review function provided by a senior SQEP criticality professional and sign off at managerial level (both by criticality team management and plant operations management). The licensee should be able to provide evidence of the QA process itself, and which individuals are authorised under the process to perform the QA functions. The QA process should conform to modern standards.  [ONR recognise that not all licensees will necessarily have a post of “criticality team manager”. In such cases it would be acceptable for sign off to be provided by a senior SQEP criticality assessor appointed to this role by the licensee’s senior management]. | The inspector should consult other specialist ONR inspectors to ensure that the QA process is compliant with modern standards and is adequately maintained.  The inspector may wish to sample the QA process itself and the list of approved peer reviewers/approvers and check a sample of CCCs/point of work instructions to see that there are no signatures missing, no delegation of sign-off to non-SQEP individuals and that no on-plant documentation is in draft or “un-QA’d” form. In addition, the inspector may wish to confirm that only approved individuals are performing the QA role(s). |
| 1. What checks are made of accurate translation of limits and conditions from the criticality safety assessment to the CCCs/point of work instructions? | The licensee should provide evidence that the criticality safety assessments, from which the limits and conditions are derived, have been performed by SQEP criticality assessors with adequate QA oversight. The same should be true of the CCCs. In particular, the CCC/point of work instruction QA process should include a step aimed at confirming that Limits and Conditions have been accurately translated into the CCCs/point of work instructions in a way that ensures that their original intent is fulfilled. | The inspector may wish to consult other ONR specialists to identify whether the licensee’s quality assurance process is adequate and conforms to modern standards. The inspector may wish to sample a criticality safety assessment and the subsequent CCC/point of work documents to see if the limits and conditions from the assessment have been accurately and intelligibly translated. |
| 1. Are the facility operations staff, their supervisors etc. who will be required to work to the CCCs/point of work instructions involved in the production of the documents? | The licensee should be able to show evidence during the CCC/point of work instruction drafting process that the potential users of the documentation have been considered and adequately consulted while writing the Limits and Conditions within the CCCs/point of work documents. This should involve, but is not restricted to, sign off of the CCC/point of work documents by on-plant representatives/plant managers. | CCCs/point of work instructions and the limits and conditions therein should be written in a way that is easy to understand and demonstrate compliance against, minimising the risk of misunderstanding or misinterpretation by operators. Therefore, involving the operators and plant managers/supervisors in the drafting process is important to minimise the potential for occurrence of such issues. |
| 1. Does the licensee seek/obtain any feedback from the workforce on ease of interpretation of CCCs/point of work instructions? The inspector should seek evidence of this process. | The licensee should be able to provide evidence of the mechanism that operators could use to feed back on the ease of interpretation of CCCs/point of work instructions and also provide evidence where this feedback has occurred, and the resulting action taken to improve the clarity of the CCCs/point of work instructions. In addition, the licensee’s criticality safety team should be able to provide evidence of taking a proactive approach to this consultation with operators/managers/supervisors etc. i.e., checking CCC/point of work instruction intent against interpretation by operators etc. The licensee should be able to provide records of issues raised in this manner and their satisfactory rectification. | Issues with misinterpretation of CCC/point of work instructions limits and conditions may be emergent and therefore not picked up on during the drafting process. A proactive attitude by the criticality team will ensure that these issues are identified earlier, as complete misinterpretation of the CCCs/point of work instructions by the operators may not be noticed and reported. Keeping a record of issues raised in this manner will allow the licensee to learn from experience and avoid repeating similar problems elsewhere. |
| 1. What actions are taken if adverse feedback is obtained from plant operators, managers etc. on ease of use/interpretation of CCCs/point of work instructions? | In an instance where negative feedback has been received regarding the interpretation or consequences of a limit or condition in the CCC/point of work instruction, as implemented on plant, ONR would expect licensees to retain a record of this feedback, including the nature of the problem, who in the criticality team addressed it and how it was closed out (including, if necessary, the re-issue of CCC/point of work instruction). The licensee should be able to demonstrate a willingness to learn from issues/feedback that arises and take steps to ensure a similar scenario will not occur again. | The level of response to the adverse feedback would be expected to be proportionate to the seriousness of the issue identified. For example, if strict adherence to the wording of CCC/point of work instruction wording led directly to a potentially unsafe fissile material or plant configuration, or began driving unsafe behaviours/work-arounds, this would need to be addressed urgently. |
| 1. Is the CCC/point of work instruction clearly authorised - ideally a CCC/point of work instruction should be authorised by a senior criticality safety professional and also be endorsed by an authorised senior member of the licensee’s management team e.g., the plant manager for whose plant the CCC/point of work instruction applies and/or senior safety assessment professionals within the licensee’s organisation? | ONR expects the CCCs/point of work instructions to be authorised by a senior criticality safety professional and endorsed by an appropriate and authorised member of the licensee’s management team. The CCC/point of work instruction QA process should include provision for this approval step. The criticality group should be able to provide evidence that CCCs/point of work instructions have passed adequate QA scrutiny and have plant management acceptance, as the operators will be the ones using the CCCs/point of work instructions and must be content that it is practicable to adhere to the limits and conditions within these documents. Anyone performing this plant management acceptance role must be considered and appointed SQEP for this role and be authorised by the licensee to perform this role.  [ONR recognise that within some licensees the safety case may be managed by a Safety Case Manager/Owner and in such cases, it would be ONR’s expectation that evidence of CCCs/point of work instructions having successfully passed QA scrutiny should be sought from this individual(s) rather than the criticality safety group]. | Sampling of CCCs/point of work instructions present on plant should be undertaken, to ensure they are signed as authorised by the appointed plant management representatives. The inspector may seek to ascertain from the licensee as to who has been authorised by the licensee to sign the CCCs/point of work instructions in this capacity. |
| 1. Can the limits and conditions on the CCCs/point of work instructions easily be complied with e.g., if the criticality control is the concentration of neutron poison in a vessel being above a set value, then how would an operator on the plant be able to ascertain that the poison is present at this required level? | ONR expects CCCs/point of work instructions to be written so that they can be accurately interpreted and easily used by plant operators. The licensee’s criticality group should be able to demonstrate that the limits and conditions, generated for use in the CCCs/point of work documents, are meaningful, permit straightforward demonstration of compliance and keep the number/nature of compliance checks to a manageable level. Any checks required for demonstration of compliance with the CCCs/point of work instructions should themselves be meaningful, straightforward to execute, be manageable in number and robust. The CCCs/point of work instructions should themselves be written in plain English. The CCCs/point of work instructions should contain all the relevant criticality safety information and should not require reference to several other documents and/or calculation tools to confirm levels are within safe limits. | Providing a large series of limits and conditions in CCCs/point of work instructions, where demonstration of compliance is convoluted or difficult, encourages a culture of work-arounds and shortcuts. Compliance should be easy to demonstrate and not involve a requirement (for instance) involving a physical property value when that property is not directly measurable (or not easily derived from direct measurements of other physical properties). |
| 1. Has/does the licensee benchmark their CCCs/point of work instructions against those produced by other licensees? | The licensee’s criticality safety team (in the case of some licensees it is recognised that this role could also be discharged by a plant facing safety case team) should provide evidence that they routinely and proactively engage with criticality safety professionals at other licensees in the sector e.g., through workshops, exchange visits, routine meetings, and other fora (e.g., WPC), conferences and other gatherings where OpEx is discussed. The licensee should be able to provide evidence that it is collating and making use of OpEx both from within its own organisation (e.g., from different operating sites) and between the licensee and other organisations that handle similar materials / use similar processes. | The inspector should be mindful of any commercial / information security considerations that may restrict direct discussion of practices with other licensees. |
| 1. Are the CCCs/point of work instructions readily accessible to those persons controlling operations and ensuring the relevant limits and conditions are met? CCCs/point of work instructions should normally be displayed in those areas to which they apply. | The licensee should maintain a list of all current CCCs/point of work instructions on plant, with location and issue number information. The CCCs/point of work instructions should be readily accessible to all those who need to see the documentation, on or near the workstation to which it applies, and those operators using the documentation should be able to demonstrate a working knowledge of its contents and key requirements. | The inspector may wish to test the knowledge of operators handling fissile material to see if they understand where to go for the CCC/point of work instruction information, by asking them to identify the CCC/point of work instruction and to summarise its meaning and key requirements (e.g., limits and conditions). The operators themselves would be expected to have a good awareness of the key factors affecting criticality safety and should understand what is required to maintain safe operations on their station within the limits of the CCCs/point of work instructions. |
| 1. Are CCCs/point of work instructions displayed on plant suitably legible e.g., could operators with impaired vision still reasonably be expected to be able to read the documents and are the CCCs/point of work instructions protected from damage e.g., by being laminated, placed in protective frames? | ONR expects CCCs/point of work instructions to be clearly displayed, in a useable condition, with their locations known and identifiable by the operators. CCCs/point of work instructions should be readily identifiable as CCCs/criticality related point of work instructions. The wording of the CCCs/point of work instructions should be clear and sufficiently large for those with visual impairment to read, should be signed off and in date (where an expiry date is posted on the documents), and should not be subject to any impediments to their readability (e.g., operational graffiti, sticky notes and other notices overlapping). | The inspector should consider testing operators/supervisors on their knowledge of the location of the CCCs/point of work instructions and to sample a set of on-plant CCCs/point of work instructions to see if they are easily accessible, in-date and legible (including having readable wording and not being obstructed/damaged). |
| 1. Are the CCCs/point of work instructions posted on the plant included within an adequate document control system maintained by the licensee? Does the licensee’s document control system prompt reviews of the CCCs/point of work instructions (including reviews of the physical condition of all such documents posted out on the plant) with an appropriate periodicity and is the responsibility for conducting such reviews clearly defined? | CCCs/point of work documents should be maintained on plant in a current state and in adequate physical condition, with full signatures (where required). It would be expected that there is a well-established and adequate document control system activity for review and inspection of all CCCs/point of work documents posted on the plant, with a clear responsibility for discharging the inspection/review activity.  ONR would also expect, as a matter of good practice, that the licensee’s criticality section would maintain a log with the locations of all CCCs/point of work instructions posted on the plant, their associated expiry dates etc. It is good practice for the criticality safety group to be able to demonstrate evidence of periodic review of all CCC/point of work instruction content and that it conducts its own checks on plant to ensure all CCCs/point of work documents remain clear, visible, legible and in date. The results of these plant walk-downs, including the identification of any expired, damaged or illegible CCCs, should ideally be clearly recorded and actions generated to rectify the issues in a timely manner.  [ONR accept that such checks may not always be the remit of the licensee’s criticality safety team but could also be adequately discharged by a plant facing safety case team]. | The ONR inspector may seek to sample the licensee’s document control system, to ensure that responsibilities for inspection and review are clear.  The inspector may also wish to ascertain whether the licensee’s criticality safety function conducts its own periodic checks on criticality safety documentation available on the plant and whether any such periodic checks are documented. |
| 1. Are the licensee’s CCCs/point of work instructions constructed to a standard format across the licensee’s site(s)? | The licensee should have a standard template from which CCCs/point of work instructions are constructed, in order to ensure that CCCs/point of work instructions are readily identifiable as being key criticality safety related documents and the information within them is clear and easy to find. The licensee should consult on-site personnel in the drafting of the CCC/point of work instruction template, in order to ensure the information contained therein is as clear as possible. CCCs/point of work instructions posted on site should adhere to the common standard template. | The ONR inspector may sample CCCs/point of work instructions on plant to see if they conform to a common format and may seek to understand from the licensee’s criticality group as to how the common template was developed and (if necessary) is reviewed. |
| 1. Do the CCCs/point of work instructions have a clear expiry/review date on them and are all displayed CCCs/point of work instruction documents in date? | CCCs/point of work instructions contain the limits and conditions for safe operation on plant from a criticality perspective, and as such it is expected that all CCCs/point of work instructions on plant are in date and based on the most recent criticality safety assessments. It is expected that CCCs/point of work instructions on plant show evidence of an expiry/review date (which links back to an adequate document control system which prompt a regular review of this documentation). | The inspector may sample CCCs/point of work instructions on plant to check that they are adequately signed off, where required, with clear review dates (and are consequently still in date). Any CCCs/point of work instructions found to have exceeded their review date, to have no review date, or to be in unsigned/draft form, may suggest an ineffective document control/review process. |
| 1. How are the expiry/review dates of CCCs/point of work instructions tracked by the licensee and how is their process for CCC/point of work instruction review triggered? | The licensee should show evidence of periodic review of CCCs/point of work instructions for content and clarity as well as provision for updates if new information becomes available between review dates.  In addition to licensee’s having an adequate documentation control system, it is considered by ONR to be good practice for the criticality group (or a plant facing safety case team) to hold an up-to-date list of current on-plant CCCs/point of work instructions alongside their proposed review dates. These review dates should match the dates written on the actual certificates/documents on plant. The maintenance of such lists should allow the criticality team (or plant facing safety case team) to send reminders ahead of time when CCCs/point of work instructions are about to expire, to allow sufficient time for criticality assessors to review and up-issue the documents. | The list of CCCs/point of work documents may be sampled i.e., to identify if any have expired and to ascertain how the licensee’s system flags up upcoming expiries and ensures their timely replacement. The inspector could also sample associated CCCs/point of work documents on site, i.e., to check that their expiry dates are visible and match those stated on the licensee’s document control/review schedule. |
| 1. What is the licensee’s process for reviewing and re-issuing CCCs/point of work instructions and does the review date (on CCCs/point of work instructions) include ample allowance for any necessary reassessment work to minimise the risk of expiry dates being challenged (i.e., requiring temporary CCCs/point of work instructions to be put in place)? | The criticality group (or plant facing safety case team) should have an established and robust process in place to send alerts when a CCC/point of work instruction is reaching its expiry/review date, with a clear process (and associated responsibilities) for up-issuing (if required) the CCC/point of work instruction before the expiry date lapses. The review should be performed by a SQEP person (the licensee should have a list of who has current training and is considered SQEP for this role). The process should contain contingency measures should the CCC/point of work instruction expire, including guidance on the maintenance of safe operations in this scenario. | The inspector may wish to sample a CCC/point of work instruction that is about to come up for review and to ascertain from the licensee’s criticality safety team (or plant facing safety case team as appropriate) what their process is for reviewing and re-issuing the document(s). The inspector may wish to sample a recently-reviewed CCC/point of work document against the licensee’s established review process i.e., to check that due process has been followed. The inspector may also want to consider the licensee’s workload for CCC/point of work instruction review i.e. to make sure the licensee’s y team undertaking these duties are sufficiently resourced to update CCCs/point of work instructions before their expiry/review dates. |
| 1. What records are generated and retained for this CCC/point of work instruction review process? | The licensee’s criticality group (or plant facing safety case team) should maintain a record of the review process, in order to demonstrate that due process has been followed and to capture any learning from experience that may be applicable to other CCCs/point of work instruction documents when they come up for review. The licensee’s criticality group/plant facing safety case team should maintain these records for an appropriate length of time in accordance with their arrangements. | The ONR inspector may sample the records from a recent review and question the licensee’s criticality group (or plant facing safety case team as appropriate) on how information from this review process is archived (and for how long) and used. |
| 1. When a CCC/point of work instruction is first implemented and/or if a CCC/point of work instruction changes following review, then how are staff trained in the changes to the CCC/point of work instructions and how is this training recorded? | New CCCs/point of work instructions, or CCCs/point of work instructions that change following a review, could lead to new operating rules/instructions on plant. ONR expects new CCCs/point of work instructions and changes to old CCCs/point of work instructions to be readily and clearly communicated to the appropriate representative on plant (Criticality Safety Representative or similar, who should have been involved in the change process) with evidence that this step has been completed and the information understood. ONR expects operators, supervisors, duly authorised persons (DAP) etc. to be appropriately trained in the requirements of any amended or new CCCs/point of work instructions. Evidence should be available to demonstrate that understanding of the new requirements has been tested. ONR expects a record to be kept demonstrating delivery of appropriate training for new/amended CCCs/point of work instructions and that this information has been received and understood by operators/supervisors etc. | In order to sample in this area, the ONR inspector should identify a new or recently amended CCC/point of work instruction document and ascertain from the licensee’s criticality team as to how the changes are relayed to key plant personnel (especially operators, supervisors and DAPs). How are the plant personnel trained in the changes? The training records, demonstrating that this information has been disseminated and signed off as understood, should also be sampled. |
| 1. How is the licensee’s staff’s understanding of the requirements of the CCCs/point of work instructions tested? | The criticality group (or plant facing safety case team as appropriate) as part of their CCC/point of work instruction update process should have provision to explain changes to operators; supervisors etc. and ensure the changes are adequately understood. The licensee should be able to demonstrate a robust process by which all personnel required to be briefed/trained in the changes are identified in advance of training/briefing delivery. The operators, supervisors etc. should be able to describe the key safety actions required of them, should a breach of criticality clearance occur, or should a situation arise outside of normal conditions of operation, without reference back to the on plant CCCs/point of work instructions. Operators/supervisors etc. should also be able to explain what changes have been made and how this impacts their working practices and the key controls maintaining safety on the plant. | The ONR inspector should sample the CCC/point of work instruction update process requirements to ascertain how key changes to criticality safety documentation are explained/trained and how understanding is then tested. The licensee’s process, for identifying all those requiring training delivery, should be probed in order to judge its adequacy. The inspector may also conduct some reassurance discussions on-plant e.g., by testing operators’ knowledge of a recently changed CCC/point of work instruction and asking how plant personnel are alerted to/trained in the new /changed CCC/point of work instruction requirements. |
| 1. Does the licensee generate/issue temporary CCCs/point of work instructions and if so, then how is this process controlled? | Temporary CCCs/point of work instructions should not be used unless absolutely necessary, and the licensee should be able to provide a clear justification as to why they are being used in preference to permanent documentation. Such criticality documents should have clear validity time limits (ideally no more than 3 months from the date of issue) and should follow the same level of rigorous production QA and change control as permanent CCCs/point of work instructions.  ONR note and accept that for some licensees the criticality safety documentation is ‘owned’ by (for instance) a plant facing safety case team, or a safety case ‘owner’ or manager, rather than the criticality safety team. It is also noted and accepted that temporary changes to existing CCCs may be via the issue of an Addendum, which is then withdrawn at an appropriate time rather than amending/re-issuing the parent CCC/point of work document.  However, the licensee should be able to clearly demonstrate (via maintained records etc.) the status of all of its criticality safety documentation and which (if any) criticality documents have temporary status. The licensee should be able to justify why it was necessary to issue a temporary document. The licensee should also be able to demonstrate it actively tracks the lifespan of temporary criticality documents and that these are being removed and replaced in a timely manner. | The ONR inspector should seek justification from the licensee as to why temporary criticality safety documentation is in place, what process has been used for its creation and how it is being controlled. The inspector should sample any temporary CCCs/point of work instructions to inform a judgement as to whether the documentation conforms to the licensee’s standards for permanent CCCs/point of work instructions (in terms of layout, sign-off, etc.). Frequent and widespread use of temporary CCCs/point of work instructions may be symptomatic of wider organisational planning issues. |
| 1. What time limits are imposed on temporary CCCs/point of work instructions? Ideally a temporary CCC/point of work instruction should not be in force for of the order of more than circa 3 months. | Time limits should be clearly stated via expiry dating and a record of why a temporary CCC/point of work instruction is in place for that length of time. The licensee should be able to demonstrate that all temporary CCCs/point of work instructions have sensible and clearly defined expiry dates on the document control schedule (or other similar criticality safety group/plant facing safety case team maintained tracking schedule) and should demonstrate a clear plan for replacing these with permanent versions. | The ONR inspector may wish to sample the document control schedule or criticality safety group/plant facing safety group maintained schedule for temporary CCCs/point of work instructions to check they have reasonable expiry dates, and none have already expired. The inspector may wish to also sample temporary CCCs/point of work instructions on plant, to check there is a clear expiry date specified on them. |
| 1. Is there any evidence of temporary CCCs/point of work instructions being repeatedly extended? If repeated extensions have been necessary, then why has the licensee not produced permanent CCCs/point of work instructions? | Repeatedly extending temporary CCCs/point of work instructions is potentially evidence of poor future planning and change management control. The licensee’s criticality group should minimise repeated extensions as much as possible, but if it is considered unavoidable the licensee should be able to provide adequate justification as to why this was necessary, as well as justification for why operating risks continue to be ALARP. The licensee should demonstrate what plans are in place to replace the temporary CCC/point of work instruction with a permanent one as soon as reasonably practicable. | Although not as concerning as an expired temporary CCC/point of work instruction, or a temporary CCC/point of work instruction with no expiry date at all, repeated extension may be symptomatic of wider planning or cultural issues that the ONR inspector may wish to explore with other specialist ONR colleagues (e.g., LMfS and HF). |
| 1. Does the licensee keep a centralised log of all CCCs/point of work instructions (including any temporary CCCs/point of work instructions) issued and posted on the plant, together with their actual locations? | ONR expects the licensee to have a readily accessible and up to date list of current CCCs/point of work instructions on plant, complete with location, responsible assessor, and expiry date. The licensee should be able to show that this list is up to date and explain who is responsible for maintaining the list. ONR would also expect the criticality team to have central copies of each of the CCCs/point of work instructions for reference.  ONR accept that at some sites, although the criticality safety assessors may have access to a safety case document database (permitting ease of access to the most up to date documents) the documents themselves will be plant owned and controlled. | It may be appropriate for the ONR inspector to sample any maintained log of issued/posted criticality documentation and check it for accuracy by sampling on-plant CCCs/point of work instructions. The ONR inspector may also wish to engage with the licensee’s criticality team (or plant facing safety case team if appropriate) to ascertain who has responsibility for the maintenance of the log and what contingencies are in place for that person being absent for extended periods. |
| 1. How is the physical boundary for the applicability of a CCC/point of work instruction established on the plant e.g., are criticality station boundaries clearly marked out on the plant? | The CCC/point of work instruction should clearly state the boundaries of applicability, and these boundaries should translate to clearly observable physical boundaries on plant (e.g., partitions, walls, tape markings, different floor surfaces and signs). The licensee should be able to demonstrate on plant the clear boundary of any CCC/point of work instruction. The operators should be able to demonstrate a clear understanding of the boundaries of the workstation referenced in the CCC/point of work instruction. | It would be appropriate to sample a selection of criticality stations on plant, to confirm that the station boundaries are clearly marked and maintained, that they match the boundaries stated in the accompanying CCC/point of work instruction, and that operators are aware of these boundaries and what they mean in practice. |
| 1. Are the criticality station boundary markings regularly checked to ensure they have not been eroded and remain clearly visible and extant i.e., to confirm that they have not been eroded by heavy personnel traffic over the markings etc.? | ONR expects licensees to regularly check the condition of the on-plant criticality station boundary markings (i.e., for visibility, clarity and compliance with the relevant CCC/point of work instruction), as part of planned routine plant walk downs. It is also expected that these walk-downs will promptly highlight any adverse findings to the plant management, for timely rectification. Any such adverse findings should be documented in the walk-down report and the licensee should be able to demonstrate that appropriate action has been taken promptly to address the finding. | A selected number of criticality stations should be sampled to see if the station boundary markings are correct (i.e., as compared to the CCC/point of work instruction), obvious and not worn/damaged. The inspector may also wish to engage with the plant operators to ascertain their understanding of how the boundaries are maintained, how often they are inspected (and by whom) and to whom any problems are reported. Plant walk-down reports may also be sampled to ensure that problems with criticality station boundaries are being adequately identified and flagged to the plant management. |

**Note**: The ONR inspector should note that if the CCC/point of work instruction has to be supported by other clarifying documentation, or by extensive notes on the CCC/point of work instruction itself, then the CCC/point of work instruction does not satisfy ONR’s expectations or RGP. CCCs/point of work instructions should be short, written in plain English and give clear and unambiguous instructions. Limits and Conditions (L&C) on the CCC/point of work instruction should be clearly flagged as such and should be written so that compliance can easily be checked/confirmed (e.g. an adequate L&C might be phrased around ensuring the total mass of fissile material present does not exceed x kg – with a calibrated balance present to allow the operator to verify this, a poor L&C might specify a maximum density of the fissile material present, which the operator can make no direct/easy measurement of).

# Appendix 9 – Licence Condition 24: Operating Instructions

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Is it clear for each criticality station within a plant/ facility (i.e., on the CCC/point of work instruction) what the primary modes of criticality control are (e.g., limited mass, concentration, volume, moderator)? | ONR will consider the effectiveness of the Operating Instructions to communicate safety case requirements and associated measures (i.e., engineered, or procedural) to ensure criticality safety functions will be delivered when demanded. ONR expects these instructions i.e., in the case of criticality safety the CCCs/point of work instructions to be easy to read, unambiguous and clearly intelligible to the operators. The CCC/point of work instruction should clearly specify its regions of applicability and its mode(s) of criticality control. | The ONR inspector should sample on-plant CCCs/point of work instructions and may choose to engage with the plant operators of particular criticality stations to ascertain their understanding of the key criticality safety controls in place; in particular the inspector may wish to obtain assurance that the operators understand how this mode of control is to be achieved by the required operator actions (where such actions are required) on plant (i.e. in adherence to the criticality related operating rules and instructions).  The inspector may also wish to sample how the licensee tests the understanding of its operators in key criticality safety controls associated with a process and any required operator actions stemming from these controls.  It should be noted that operator actions may not be required in all circumstances to maintain parameters within specified limits. For instance, primary criticality controls may be engineered into storage or handling equipment (criticality control for fuel stored in a pond is maintained by the design of the fuel storage racks to ensure the spacing of fuel assemblies and where required the presence of fixed neutron poisons – these cannot be affected by operator actions and in such circumstances the operators only need to abide by a requirement to place the fuel assemblies within the racks). |
| 1. Are operators clear as to what actions they should take if a breach of CCC/point of work instruction limits or conditions is identified? Ideally, if safe to do so, operators should ‘walk away’ from the affected operation, cease other operations in the immediate vicinity and inform management immediately. No immediate attempt should be made to recover from the breach. | ONR expects operators to be adequately informed of the course of action they are required to take, should a breach of the CCC/point of work instruction(s) limits and conditions be identified. These actions should be clearly identified on documentation readily available at the criticality station/point of work and operators should have received adequate training in their required actions. Accordingly, operators should be able to verbally demonstrate a clear knowledge of the actions to take immediately following a breach and know who to contact in such an event. The criticality safety team would be expected to have nominated specialists ‘on call’ during plant operation to provide prompt advice to the plant management in the event of any such breach occurring.  ONR accept that at some sites it is not always necessary to have a 24 hour ‘on-call’ provision and a ‘call-out’ provision may be a more suitable arrangement. | The ONR inspector should discuss the expected contingency arrangements, following a suspected breach of a CCC/point of work instruction limit or condition, with the plant operators (to confirm their understanding). The inspector should also engage with the criticality team lead (or the safety case owner or manager where a criticality team lead post does not exist) to confirm that an ‘expert on-call’ facility is available to plant managers to offer criticality advice following a breach of the CCC/point of work instruction.  ONR consider it good practice for there to be a nominated ‘on call’ SQEP criticality assessor during all daylight plant operating hours who can respond promptly to such breaches. Arrangements for a ‘call-out’ provision should be in place where operations are conducted during ‘silent hours’. The criticality/safety case lead may wish to produce an ‘on-call’ rota as evidence of its arrangements in this area. The inspector may also seek to ensure plant operators/management understand the procedure following a breach and how to contact the ‘on-call’ criticality assessor.  The inspector should ensure that the OIs have been written in such a way that the operators are unlikely to create ‘work arounds’ e.g., try to ensure there are no steps in the OIs that the operators might try to combine for efficiency, or steps which may be taken out of sequence by the operators to make a task quicker. The inspector may wish to seek advice from ONR specialist human factors inspectors in this context. |
| 1. Does an operating instruction exist defining the actions to be taken by operators in the event of breach of a limit/condition on a CCC/point of work instruction? | CCCs/point of work instructions should contain an operating instruction clarifying the action(s) to be taken in the event of a breach of a limit or condition of the CCC/point of work instruction. This operating instruction should be unambiguous, readily intelligible to the operators and its target should be to promptly deliver a stable state to minimise risk to the operators and other plant personnel (e.g., by the operators immediately walking away and seeking assistance, or by taking certain specified actions before seeking additional advice/assistance). The instructions should not depend on operators contacting specific named individuals but should instead depend on contacting roles, such as ‘on-call criticality specialist’, Duly Authorised Person (DAP) etc. with associated contact details being provided). Any breach of a limit or condition occurring on a criticality station should be used as an opportunity to further refine (if appropriate) the contingency arrangements reflected by the operating instruction. | CCCs/point of work instructions should be sampled to ensure that such contingency instructions are present and are written in plain language that is readily intelligible by the operators. Engagement with operators should be undertaken to test their knowledge of the steps to take in the event of a breach of a limit and condition on the CCC/point of work document. The presence of the support roles, to provide expert advice should such an event occur (e.g., on-call criticality assessors, DAPs, supervisors, and managers) should be confirmed and the inspector should sample from these roles to ensure the relevant personnel are fully cognisant as to their role responsibilities. |
| 1. If the CCC/point of work instruction defines moderator or geometry restrictions for criticality stations on the plant, then how is compliance with these limits/restrictions enforced and evidenced? How often are checks made and documented on compliance with such limits/restrictions? | ONR expects compliance with criticality controls to be simple to demonstrate (using measurable quantities at the criticality station and not relying on conversion /unclear surrogate parameters etc.). In the case of moderator restrictions, it would be expected that moderator is limited to levels as low as reasonably practicable (given work/process requirements) and any liquid moderator present should be in volume limited bottles which are clearly labelled. The licensee should have clearly documented methods for identifying the amount of liquid and other moderators present at each criticality station. Moderator holdings should be kept up to date and a log of moderator holdings should ideally be maintained at each criticality station.  For any criticality related geometric restrictions, work areas (criticality stations) should only contain vessels that conform to the geometric restraint and should not be cluttered with other containers that are not safe-by-shape. ONR expects these arrangements to be regularly checked for compliance (e.g., through planned, routine, and documented plant walk-downs). The results of these compliance checks should be recorded. The licensee should have clear requirements/processes for rectifying any breach of compliance and have an established method(s) for returning a criticality station to compliance. | Plant operators should be able to adequately explain how compliance with moderator and geometry limits is established and maintained. Evidence should be sought of the presence of moderator logs on or near to criticality stations and that these are clearly being managed and routinely updated. The operators should also be able to explain how often compliance checks are made and how these checks are recorded. The ONR inspector may wish to sample some of these records to see that the checks have been completed according to the licensee’s processes/operating instructions and any issues have been raised promptly. Resolution of a number of sample issues should be traced. |
| 1. How are quantities of moderator (solid and liquid) tracked on each criticality station on the plant e.g., what logs are kept and are these easy to interpret? | If movement of moderator between criticality stations or on to a criticality station is required, ONR expects there to be a clear and well maintained and documented movement and tracking system and station moderator logs are in place, for purposes of accountancy and for ensuring that individual criticality station moderator limits are not breached. ONR expects the moderator logs to clearly state moderator quantities (mass or volume, as appropriate) that are in each criticality station. The accountancy records should be current and easy to read. It is expected that the licensee will be able to demonstrate, via appropriate documentation, that periodic audits are conducted of the log accuracy. Documented procedures should also be in place as to actions to be taken if moderator holdings are found to be inaccurate on a criticality station and/or if a moderator limit is breached. | Moderator logs should be sampled for legibility and to allow comparison against current moderator holdings in a sample of the criticality stations to check the accuracy of the licensee’s moderator management system. The ONR inspector may also wish to engage with the operators to form a judgement as to their knowledge of the log, how moderator is controlled within the facility criticality stations and what to do if problems arise (e.g., if inaccuracies/errors are discovered or if excess moderator is found – i.e., a breach of the moderator limits for the station).  If possible, during the inspection spot checks of moderator holdings, versus the moderator limits against the on-plant logs of moderating materials should be conducted. |
| 1. Are there any obvious threats on the plant of ingress of liquid moderator onto criticality stations e.g., leaks in the building fabric in the vicinity of fissile material and steam/liquid carrying lines passing over/through areas where fissile material is present? What precautions has the licensee taken to limit the potential for contact of liquid moderator from any such sources with the fissile material? | ONR expects threats of liquid moderator ingress to criticality stations to have been identified and addressed at the earliest stages of plant design and if possible, to have been engineered out (e.g., by rerouting pipework away from criticality stations). Ingress of excess liquid moderator onto a criticality station should be prevented during normal plant operations and consideration should have been made by the licensee to fault sequences in which liquid moderator could feasibly be introduced. Efforts should be made to provide engineered (preferred) or administrative controls to reduce the risk as low as reasonably practicable. The licensee should demonstrate adequate defence in depth and should consider the double contingency principle (so that introduction of excess moderator alone onto a criticality station is not sufficient to bring about a critical configuration of the fissile material present). | As required, other specialist ONR inspectors (e.g., fault studies and civil engineering) should be consulted in reaching a judgement as to whether the risks of unplanned liquid moderator ingress onto a criticality station have been adequately addressed and are ALARP. |
| 1. If a fissile material process is subject to a CCC/point of work instruction that has fissile mass limits defined, then how are these fissile masses tracked and how is compliance with the mass limits demonstrated? | Where licensees have proposed controlling criticality safety based upon fissile mass controls, ONR expects the licensee to have clear and accurate methods in place for determining and tracking the mass of fissile material on each criticality station and to have a robust system of fissile material accountancy. Fissile masses should be identifiable and tracked through the system (e.g., via clearly labelled and/or barcoded containers). Clear, easy to use, reliable and robust systems should also be in place to track changes in fissile masses, as fissile material is moved between criticality stations. Fissile mass logs should be kept current and should be easy to read and interrogate. Information on fissile mass holdings on each criticality station should be routinely and robustly backed up to guard against any loss of information. Checks should be regularly made of the log against the actual fissile holdings situation on the plant criticality stations to ensure accuracy. Fissile mass limits should be set to be the minimum mass that process requirements demand and should give an adequate margin to that mass at which the occurrence of criticality becomes feasible. Excess fissile material, within the defined fissile mass limit, should not be stored or held in criticality stations. | ONR sampling, of the fissile material logs for a sample of criticality stations, should be conducted to ensure the actual station fissile mass holdings match those declared by the logs and lie within the fissile mass limits for the station. Control of fissile mass movements between criticality stations should also be examined to ensure appropriate checks are being conducted to ensure no fissile mass breaches occur and that the accuracy of the fissile account logs is maintained. The ONR inspector may wish to engage with the operators to ascertain their understanding of the fissile material holdings log (s), how they ensure that the log(s) is/are maintained to ensure that they are current and how fissile masses are measured in criticality stations. Evidence should be sought of routine periodic audit of both the fissile material log(s) and the findings of these audits. The licensee should have a clear process for dealing promptly with any fissile material accountancy/holdings errors and for investigating the causes of any such occurrences. |
| 1. Does the licensee maintain clearly documented records of transfers of fissile material between areas subjected to criticality control (i.e., criticality stations)? Do the records demonstrate that the applicable fissile mass limits, at the various locations, are being complied with? | Checks should be in place at both ‘sender’ and ‘recipient’ stations, and any intervening areas (e.g., ‘glovebox transfer corridors’, temporary stores, or similar) to ensure fissile mass limits are not breached at donor or receipt stations and/or at criticality stations on the move route. In addition, movements of all fissile material and moderator should be tracked from move commencement to termination. ONR expects that the licensees processes, employing fissile material, will demonstrably have high criticality safety margins (in terms of fissile mass permitted within each criticality station) and that these margins will credibly protect against any inadvertent over-batching of fissile material resulting from a fissile material move between criticality stations. The licensee should maintain records of all fissile material moves for accountancy purposes. These records should be unambiguous and up to date, such that any past arrangement of material could be easily deduced by ‘working backwards’ from the current state using the log. | Fissile material move records should be sampled for their clarity and accuracy and engagement with the operators should be undertaken to fully understand the licensee’s process involved in making fissile material moves (including understanding what the process requires in the way of record keeping and pre/ post- move checks).  [Note: ONR inspectors have encountered both computerised and paper based fissile material movement systems. Both are equally valid and have their own advantages and disadvantages. However, the key purpose of any such system needs to be demonstrably realised i.e., that the licensee continues to maintain an accurate knowledge of the locations and masses of its fissile material at all times. In addition, the licensee should be able to demonstrate that at any point in time and throughout any planned fissile material move, the total fissile mass present at any criticality station lies within the fissile mass limit established by the licensee’s criticality assessment and is as reflected on the extant CCC/point of work instruction]. |
| 1. Do the licensee’s plant records also contain any other information, required for fissile material control e.g., enrichment, chemical composition and container details? | ONR expects all aspects of criticality safety control i.e., Mass, Absorbers, Geometry, Interaction, Concentration, Moderation, Enrichment, Reflection and Volume (MAGIC MERV) that are required for criticality control on a criticality station, to be considered within the licensee’s criticality safety assessment and that any resultant limits and conditions will be reflected in the limits and conditions imposed by the CCC/point of work document. Additionally, ONR expects there to be a means to control by an appropriate means and record control of any of these parameters, at the criticality station, which are subject to limits and conditions specified by the CCC/point of work document. The licensee should be able to demonstrate that the magnitude of the controlled parameters lie within the limits and conditions imposed by the CCC/point of work document. | The ONR inspector may wish to sample back to the licensee’s source criticality safety assessment to see how the relevant limits and conditions for particular factors affecting criticality have been derived. Checks should then be made to ensure these limits and conditions have been accurately translated onto the CCC/point of work documents. The inspector should then check how the licensee demonstrates compliance with the CCC/point of work instruction limits and conditions for a sample of the key criticality controls and what records the licensee is maintaining to demonstrate compliance. Engagement with the operators should be undertaken to ascertain their degree of knowledge of the key limits and conditions, how compliance is measured at the work face and what records they are required to maintain.  Samples should also be taken at a number of criticality stations to ensure that the records maintained demonstrate compliance with the relevant limits and conditions. |
| 1. What systems does the licensee have in place for investigating any fissile mass losses e.g., fissile mass lost whilst conducting a process? Does the licensee have a system for assigning missing fissile mass to the location at which the loss occurred and subsequently summing that mass with any other fissile mass entering the criticality station (i.e., to ensure that there is no subsequent breach of the fissile mass limit on the criticality station)? | All missing (actual or suspected) fissile mass should be promptly identified, investigated and quantified (with a suitably conservative measurement error applied if necessary). ONR expects the licensee to have robust arrangements/systems in place to identify fissile mass loss as soon as practicable, to conduct thorough investigations to quantify the loss and to try to find and recover the missing fissile mass. The licensee should, through movement control and the maintenance of an accurate mass inventory for the conduct of all fissile material moves and all processes that change the form of the fissile material (e.g., oxidation and casting), have systems in place to identify the criticality station/location where the fissile mass was lost.  Whenever fissile material mass is lost then measures (e.g., such as sweeping/swabbing the criticality station down) should be taken to try to find and recover the fissile mass. Radiometric measurements may also need to be taken to try to find the missing mass.  The total fissile mass of a criticality station should include both the known fissile material stock at that criticality station, plus (if relevant) an estimate of the mass of any fissile mass known to have been lost at that station with suitable and conservative error bars applied to this mass. Mass-unaccounted-for (MUF) logs should be established, maintained and regularly reviewed to identify any trends of missing fissile material and investigate the causes. | The ONR inspector should seek to sample the licensee’s investigations into a recent fissile mass loss (or suspected loss) to understand the steps the licensee has taken to try to locate and recover the missing fissile mass and to ensure these investigative steps meet RGP and ONR expectations (advice from an ONR criticality safety specialist may be required here). The licensee’s records/documentation for its investigations should also be sampled to ensure these are robust and accurate. Where the licensee has been unable to locate and recover the missing fissile mass, has the licensee adjusted the fissile mass holding of the criticality station to include the missing mass i.e. so as to avoid potential breaches of the CCC/point of work instruction fissile mass breaches in the future? Again, advice from an ONR criticality specialist should be sought as to whether the licensee has met RGP in this area.  The ONR inspector should also sample the licensee’s fissile mass records and mass-unaccounted-for records to ensure these are clear and do not show continuing trends of ‘missing’ fissile material. Trends of missing fissile material are potentially symptomatic of poor processes, control or safety culture. |
| 1. What systems does the licensee have in place to prevent over batching of fissile material in areas subject to fissile mass control? Ideally any such systems should be engineered rather than being procedural in nature. | The licensee should have in place a suitably mature and robust fissile material movement and inventory tracking system, which is designed to prevent fissile material over-batching within criticality stations (i.e., maintains fissile masses within the relevant CCC/point of work instruction limits). Ideally, this should be an engineered control (e.g., a physical means preventing more than a certain fissile mass, or certain number of fissile material containers, being placed in a criticality station e.g., a storage rack for containers with a finite number of storage positions). If an engineered control is not available or practicable, then some form of administrative / paper-based control may be appropriate, although this must be robust and designed to minimise any potential for errors. Licensees should be able to readily identify through their records how much fissile material is in each criticality station and routine checks to prevent over-batching of fissile material should form a key step in any fissile material movement operations. Fissile masses within criticality stations should be regularly checked against the relevant fissile mass limits during plant walk-downs. There should be a sufficient safety margin in the event of inadvertent over-batching occurring (e.g., the double contingency principle should be considered in the setting of mass limits).  The licensee should also be able to demonstrate that if fissile mass limits are exceeded, a prompt and robust investigation will be conducted, and mitigating measures will be put in place to prevent a reoccurrence. | Poor glovebox inventory control/housekeeping (e.g., having significant numbers of redundant containers, tools, or other clutter in a glovebox) will make it more difficult for the plant operators to readily identify a fissile material over-batch incident / loss of fissile mass control and could be evidence of poor safety culture.  Should the ONR inspector visually identify that gloveboxes are over-crowded i.e., observe instances of poor housekeeping then the licensee should be required to address this situation promptly and adequately. The licensee should be able to demonstrate it can clearly and easily identify each item of fissile material in its criticality station and that its records, which should be clear and easy to interpret, show the mass, form, density etc. of each piece of fissile material. Some random sampling should be undertaken by the inspector to ensure the licensee is adequately compliant with ONR’s expectations in this area.  The ONR inspector may also wish to sample the licensee’s records of any investigations into any historic breaches of fissile mass control, the key findings and how future occurrence was mitigated against. |
| 1. Computerised systems for fissile mass tracking and control can be inherently complex and not amenable to traditional methods of reliability assessment. Where many fissile moves are routinely made via computerised systems (or using the assistance of such systems), then what additional controls and checks does the licensee have in place to provide confidence that the computerised systems are operating as expected? [The inspector should seek guidance on relevant good practice from an appropriate ONR expert in this field.] | Given the likely complexity of any such computerised fissile material movement control system, it would be ONR’s expectation that the safety claims made on the system will be small and that the processes being ‘policed’ by such systems will demonstrably have high criticality safety margins e.g., by the nature and shape of the materials being processed and by the exclusion by design of liquid moderators.  Any additional checks that the licensee has in place for fissile mass tracking/control should be, as far as reasonably practicable, independent to minimise the potential for common cause accountancy errors. | Notwithstanding the low-level safety claims potentially made by the licensee on such systems, the ONR inspector, when sampling control by such systems, may wish to focus on topics such as:   * The rigour of the training provided to the operators and the testing of this training. * The degree of independence in the separate checks being conducted on a fissile move. * The ease of use of the system. * Any alarms or interlocks, instigated by the system if detecting an apparent breach of the criticality related limits and conditions and the reliability of these devices. * The system back-ups and how potential data corruption faults are managed. * The operating history of the system and its abnormal events.   [Note – it would be appropriate, when sampling in the above areas, for the ONR inspector to seek advice from an ONR Human Factors specialist and an ONR Control and Instrumentation specialist, as well as from an ONR specialist in criticality safety]. |
| 1. Is there a Nuclear Material Controller (or similar role) identified who has a duty to confirm, prior to the conduct of any fissile material move, whether the movement of fissile material from one location to another (including any en-route criticality stations) meets the conditions of the CCC/point of work instruction? | The role of Nuclear Material Controller (or similar job title) should be well defined/ documented, and the nominated person(s) should be demonstrably SQEP to discharge the role. The licensee should also be able to demonstrate how the nominated person achieves and then maintains their SQEP status for this role and what the training requirements are for the role. The licensee’s fissile material movement control system should contain a specific step for the pre-move checking of fissile material masses leaving and entering various criticality stations against the relevant fissile mass limits by the Nuclear Material Controller, and logs should be kept demonstrating that the check was made and approved. All such checks should ideally be both visual in nature i.e., at the criticality stations themselves and by reference to the fissile mass records. There should be appropriate contingency arrangements in place for any situations where the nominated Nuclear Material Controller is absent or unavailable (ideally the move should be embargoed until a SQEP individual can conduct and sign off the required pre-move checks). | The ONR inspector should engage with both the plant managers and the operators regarding the role of the Nuclear Material Controller and how this role is discharged on the plant. Engagement should also be sought with a sample of Nuclear Material Controllers to ascertain their understanding of the role they are discharging and the role this plays in maintaining criticality safety on the plant. The ONR inspector should determine what checks the Nuclear Material Controllers make prior to the conduct of each fissile material move and how these checks are recorded and retained within the on-plant documentation (records should be sampled if possible). The ONR inspector should also ascertain how fissile material records are updated and checked following each successful fissile material move. The requirements for Nuclear Material Controller checks and sign off should be adequately represented in the plant Operating Instructions.  Should a fissile material move need to be aborted whilst in progress, the ONR inspector should ascertain how the Nuclear Material Controller ensures the ongoing accuracy of the plant’s fissile material records as well as returning the plant to a safe state. |
| 1. For the licensee’s fissile mass accounting system, is there an “unaccounted for” mass limit at which operations would cease for investigatory purposes? | Any such licensee limit would be expected to contain a significant margin to safety (i.e., to be set to be much less than a fully-water reflected critical spherical mass) in order to prevent the missing mass potentially accumulating into a critical configuration. In addition, the unaccounted for mass, when summed to the normal expected fissile material mases at the criticality station, should also ensure that the fissile mass limit of the criticality station will not be breached. The mass limit established for the unaccounted fissile material should also consider the nature of the fissile material and should include conservative assumptions with respect to the likely presence of any moderator, neutron poison, etc. The limit should be unambiguously and adequately represented in the process instructions and should include suitable and sufficient reporting for investigation purposes. | There should be engagement with the licensee to better understand the fissile mass unaccounted for limits on each criticality station and how the values chosen have been derived i.e. what underpinning assumptions have been used (taking account for the operations conducted at each station)? The licensee should be able to demonstrate that an adequate margin to criticality safety exists at each criticality station. The ONR inspector will wish to satisfy themselves that the Operating Instructions for each criticality station clearly define these materials unaccounted for limits and the actions to be taken when such a limit is reached and/or breached. The operator’s testing of the limits should be checked if possible. |
| 1. Are the licensee’s gloveboxes within its fissile material facilities overly cluttered? During glovebox operations an overly cluttered glovebox may indicate a potential for the licensee to lose control of the mass of fissile material and/or moderator within the glovebox and the licensee should hence be challenged where such conditions are observed to exist. | Gloveboxes should be subject to an adequate and suitably enforced routine housekeeping regime, designed to limit any potential for accumulation of items in the glovebox that are not needed for normal process requirements e.g., additional containers, tools and consumables. The gloveboxes should be uncluttered allowing the operators to conduct simple and routine visual checks on fissile material/moderator etc. holdings i.e., to allow quick comparisons to be made against the fissile mass/moderator mass limits applicable to that criticality station. The use of signs on the externals of gloveboxes, defining permitted glovebox contents, may be helpful aids to the operator and allow the plant managers/supervisors to conduct routine housekeeping check (which should be documented with actions placed to promptly address adverse findings). Where adverse findings are identified from routine housekeeping checks conducted by the licensee, ONR would expect the licensee to be able to demonstrate that these are dealt with promptly and effectively. | Cluttered gloveboxes may be an indication of:   * Problems with the licensee’s designated radioactive waste streams (e.g., the material may be orphan waste with no identified disposal route). In such cases the ONR inspector may wish to consult an ONR Nuclear Waste / Liabilities specialist inspector for further advice. * Poor housekeeping/safety culture in the facility – this should be investigated promptly with the licensee’s facility managers and a credible plan to address the problem should be put in place by the licensee in a timely fashion (the inspector may wish to sample progress against this plan at suitable intervals and the recording of an ONR Regulatory Issue may be appropriate). * Historical problems – e.g., materials from historic operations being consigned to the gloveboxes for investigation and/or processing – in such circumstances the licensee should be able to articulate a timely and credible plan for addressing the problem. * Another problem preventing good housekeeping and/or timely removal of unwanted materials from the gloveboxes – the inspector should again seek to understand the problem in the first instance and then may wish to bring in specialist ONR advice to work with the licensee to seek a mutually acceptable means to addressing the problem. |
| 1. If the CCC/point of work instruction has defined fissile material enrichment limits, then how does the licensee control these i.e., how are the differing enrichments of various fissile materials identified, verified and recorded? | Fissile material of different enrichments should be clearly labelled and the containers the fissile materials of differing enrichments are held in should be visibly distinct, i.e., in order to limit the potential for the erroneous movements/use of higher enrichment material. The differences should be clearly stated in the CCC/point of work instruction. Clear separation/segregation between lower and higher enriched materials should be maintained (ideally by engineered means).  ONR expects the licensee’s criticality safety group to perform its criticality safety assessments and to set the resulting fissile set limits and conditions assuming the most onerous credible fissile material enrichment that could be present on each criticality station. The licensee should also accurately maintain a record of the enrichment of any fissile material being moved between criticality stations. | The licensee should be able to clearly explain to the ONR inspector how it differentiates between fissile material of different enrichments, how different enrichment material is segregated/separated on the licensee’s criticality stations and how the licensee controls fissile material of different enrichments during fissile material processing, storage and movement. The ONR inspector should then seek to sample the licensee’s application of these controls on the plant to ensure their adequate implementation and should also sample appropriate documentation to ensure the licensee’s claimed controls are adequately represented in comprehensive and clearly written operating instructions. Engagement should be held with the licensee’s operators and supervisors to ensure an adequate understanding of the controls claimed. The role of the licensee’s Nuclear Material Controller in the control of fissile material of differing enrichments should be explored and tested. |
| 1. Does the CCC/point of work instruction have any fissile material concentration limits defined and if so, then how are the concentrations measured in order to demonstrate compliance? | Any limits and conditions on the CCCs/point of work instructions should be simple to measure compliance against. If fissile concentration control is required, it would be expected that operators be provided with a means of accurately measuring the concentration, ideally directly. The method provided should be simple for the operators to use and should limit any potential for errors to occur when measurements are made.  In the case of measurements of fissile concentration, the measurement method provided may, for example, take the form of multiple probes of different types (for redundancy and to provide independent means of determining the concentration). It would be expected that concentration limit checks form part of the associated operating instructions for the criticality station and should include clear requirements for the recording of the readings taken and comparison against relevant safety limits. Concentration measurements should be taken prior to and after the conduct of any process (checks at important points within the process may also be appropriate) involving the fissile material and/or prior to any move involving the fissile material. Again, documentary evidence should be available (and should be retained as a plant record) demonstrating the required checks are being conducted. | An ONR Control and Instrumentation and or Chemical Engineering inspector should be consulted when making judgements upon the adequacy of the physical measurements the licensee is making to demonstrate compliance with fissile concentration limits. Advice should be sought on both the accuracy of the methods employed and on the error margins the licensee is ascribing to the measurements.  It may also be appropriate for the ONR inspector to seek information on the training provided to the operators expected to take the measurement, how their SQEP status has been assured and how adequate supervision is maintained. Again, any role exercised by the licensee’s Nuclear Material Controller should be explored. |
| 1. Are the fissile material concentration limits the plant must operate to clearly defined i.e., in the Operating Instructions and do the operators know what actions to take in the event that such limits are exceeded (these actions should be specified in the Operating Instructions)? | ONR expects the fissile concentration limits to be set conservatively (and to include an allowance for any measurement uncertainty), allowing a significant margin to safety and ensuring that concentration-related fault sequences cannot credibly lead to a critical configuration. The fissile concentration limits and the methods used to measure and to maintain the fissile concentrations within the set limits should be specified in the Operating Instructions. The CCC/point of work instruction should also include instructions to the operators on what to do in the event of the fissile concentrations falling outside the CCC/point of work instruction limits.  Instructions on measurement of fissile material concentrations should be clear and easy to follow and should explain any values that the operators are required to record within the plant documentation. Check/sign off points for supervisors/Duly Authorised Persons etc. should also be clear within the Operating Instructions. | Sampling of the relevant Operating Instructions should be conducted to allow the ONR inspector to make judgements as to their clarity and ease of use. Engagement with the operators should also occur to seek their views as to the ease of the conduct of fissile concentration measurements, their understanding of these measurements and their purpose and to ensure the operators understand any associated obligations to maintain plant records of the measurements they take.  The operators should be able to explain to the ONR inspector those actions they are required to take if measurements indicate that the fissile material concentration lies outside of the CCC/point of work instruction imposed limits. |
| 1. Where criticality control relies upon fissile concentration limits, has the licensee’s safety case adequately accounted for the fact that precipitation of solids from fissile material solutions can occur? | For operations that involve solvent/aqueous processes, such as reprocessing, incorrect fissile concentrations and acid molarity can result in the formation of fissile rich colloids which can precipitate out of solution and accumulate. The licensee should demonstrate that fault sequences with a potential to lead to conditions where precipitation can occur have been adequately considered and that the criticality related limits and conditions (reflected on the CCC/point of work instructions) have been set so as to reduce the risk of occurrence of precipitation to as low as reasonably practicable. Where operational processes allow consideration should be given at the design stage to the use of safe by shape vessels for fissile-bearing liquids.  In addition, licensees should be able to demonstrate that sufficient and (ideally) diverse controls are in place to readily and promptly identify if the normal process conditions have deviated towards a point where precipitation of fissile material bearing solids could occur. The licensee should be able to articulate the planned contingency actions to be taken if such a deviation from normal process conditions were to be indicated from the licensee’s normal measurements/monitoring of the process.  The licensee should also be able to demonstrate that during periodic plant shut-downs, wash-downs etc. that a suitable routine is in place to survey the plant to look for any precipitation which may have occurred unrevealed by the licensee’s normal process measurements. | It may be prudent for the ONR inspector, when sampling the licensee’s safety case and process controls in this area, to seek ONR specialist advice across a number of technical fields e.g., criticality, process chemistry, chemical engineering and control and instrumentation (as appropriate for the process under consideration).  Sampling should be conducted of the CCC/point of work instruction and its underpinning criticality safety assessment, to ensure the limits and conditions derived from the safety assessment have been accurately reproduced in the CCC/point of work instruction.  There should be engagement with the plant managers/licensee subject matter experts to obtain a more in-depth understanding of the licensee’s means of controlling/monitoring the process (with the focus on protecting against fissile material precipitation); this should be compared with RGP.  There should also be engagement with the plant operators to ensure they understand the plant monitoring/measurement requirements and plant records should be interrogated to ensure any required checks/measurements are being undertaken and recorded. The plant operators should also be able to articulate the contingency actions clearly and accurately they are required to take should process conditions deviate from the stipulated safe operating envelope.  The ONR inspector should also seek to understand whether the licensee conducts any routine accumulation surveys during plant shut-downs i.e., to specifically look for any previously unrevealed fissile material accumulations. A justification will be required if such surveys are not conducted. |
| 1. What methods does the licensee employ to look for potential fissile material rich precipitates e.g., in the base of sealed vessels? | Unless a robust justification can be provided as to why such devices cannot be installed, ONR would expect a permanently installed method of measuring for any unexpected accumulations of fissile rich precipitates at the base of vessels that would be vulnerable (in terms of criticality safety) if such accumulations were to occur, and which cannot be routinely inspected by other means. Typical methods employed for such surveys include fixed neutron detectors/counters. These devices should have remote readouts (e.g., in the plant control room) and associated pre-determined ‘trigger levels’ and alarms, that allow for ready and prompt identification of precipitate formation as early as possible in the fault sequence, in order to allow sufficient time to address the problem before an unsafe condition can be reached.  Other methods to be considered by the licensee (particularly if the installation of fixed neutron monitors is unfeasible/impracticable for technical reasons) are portable neutron monitoring during plant shut-downs and/or remote fibre optic camera inspections (although the licensee may wish to justify other means). Robust and accurate fissile mass balancing across the process may also provide early indications of fissile mass losses which ONR would then expect to result in process shut-down and investigation. | In the first instance the ONR inspector will wish to understand which (if any) of the licensee’s process vessels have a geometry that could be vulnerable to the occurrence of criticality should fissile material accumulate in their base. For each such vessel the inspector should ascertain as to how the licensee is satisfying itself that no such accumulations of fissile material are occurring over time. The information provided by the licensee may require additional scrutiny by ONR specialists in control and instrumentation, process chemistry etc. (in addition to specialist criticality safety advice).  Once the inspector is satisfied that the licensee is adequately monitoring for fissile material accumulations in vulnerable vessels then the inspector should sample the licensee’s records to ensure the required monitoring is being conducted as required, that measurements are being recorded and suitably trended, that any instrumentation being deployed is suitably calibrated and tested etc.  The licensee should also be able to demonstrate that it is adequately monitoring and controlling the fissile mass balance across its process(es) and is trending such data to actively monitor for any fissile mass losses.  The licensee should be able to articulate an adequate process for investigation of any indicated fissile material losses. |
| 1. How would the licensee recover from any indicated unwanted precipitation of fissile bearing solids? | If it is feasible, the licensee should make adequate provision within the associated plant Operating Instructions to provide guidance to the operators to allow them to make suitable alterations to the plant’s process chemistry in order to return the process to its normal safe operating state/parameters (i.e., to ensure the occurrence of any fissile material precipitation is terminated promptly). However, it is recognised that it may be prudent, where the measured/indicated process chemistry has deviated into such an unsafe region, for the licensee to take no immediate action but to seek advice from appropriate experts (including criticality safety specialists) before taking any measures which could potentially further adversely affect the process chemistry.  Once a safe and stable plant state has been returned, then ONR would expect the licensee to work in close consultation with its own criticality safety experts (and if necessary, with other criticality safety experts via the UK WPC) to formulate a method to recover and stabilise any precipitate that may remain resident in the process in a manner that minimises the risk of occurrence of criticality.  ONR would expect to be kept informed throughout such events. | The ONR inspector should seek guidance from ONR specialists (e.g., chemical engineers, process chemists, criticality specialists etc.) in forming a view as to what actions the licensee might be expected to take in such circumstances and then to compare this against the licensee’s own proposals.  It should be ensured at all times through such an event that the licensee’s decision making is measured and is made with appropriate reference to appropriate subject matter experts. At all times the licensee’s focus should demonstrably be on maintaining the safety of its own personnel and the public. |
| 1. Has the licensee’s safety case adequately identified any locations where solvent could accumulate in a process and progressively ‘strip out’ fissile material, if so, then are appropriate and timely inspections of all such locations conducted and the findings recorded? | The licensee should be able to demonstrate that for each of its fissile material processes where solvent and fissile material are present, the licensee has performed a thorough engineering review of all process lines, vessels, sumps, catch-pots etc. and has thus pre-emptively identified areas where any solvent accumulation is credible. The licensee should be able to demonstrate that during any such review, expert opinion has been obtained from relevant subject matter experts.  For any such identified locations, the licensee should be able to articulate how it monitors for and protects against any solvent accumulations (e.g., by the installation of neutron monitoring equipment, by the use of drain points at any dead spots where solvent could accumulate or the installation of sight glasses).  From appropriate plant records the licensee should be able to demonstrate that it has appropriate routines in place to monitor all such locations, via its installed monitoring measures, for the presence of solvent. The periodicity of these routines should be justified by the licensee and should be such as to ensure that any solvent presence is identified and dealt with well before any fissile material accumulation in the solvent could lead to the threat of criticality.  The licensee should have documented processes in place to effectively deal with any identified solvent accumulation. | Licensee records should be sampled to ensure the licensee has considered the potential for solvent accumulations within any processes where both fissile material and solvent is present (advice may be required from an ONR chemical engineering inspector to confirm the licensee’s analysis has been comprehensive and accurate). The licensee should be able to articulate what monitoring it conducts for the presence of solvent at any locations where its studies have indicated solvent accumulation has a potential to occur. Plant records should then be sampled for the monitoring of any such locations i.e., to ensure the monitoring is being conducted and recorded and also to ensure it is being conducted at the periodicity specified by the licensee (which itself should be justified by the licensee and be documented).  The licensee’s processes for recovering any accumulated solvent should be sampled and advice should be obtained from an ONR criticality safety specialist to ensure any such recovery operations take due account of criticality safety. |
| 1. Do the operators have clearly defined actions to take in the event that accumulations of solvent/fissile material are detected at such locations? | The licensee’s Operating Instructions should clearly identify any locations on plant (and/or within a process) where there is a potential for solvent to accumulate and to strip out fissile material over time. The steps to be taken by the operators to routinely interrogate such locations for any solvent accumulation and the actions to be taken should solvent be discovered should be clear within the Operating Instructions.  [NB – should solvent be detected then it would normally be prudent for the immediate operator actions to require reporting the findings up their plant management chain, for the plant/process to be placed into a safe state and for a recovery plan to be formulated involving the licensee’s relevant subject matter experts. Hasty unplanned actions should be avoided, and the safety of plant and other operator personnel should be paramount at all times]. | The ONR inspector should obtain advice from relevant ONR specialists e.g., process chemists, chemical engineers, and criticality specialists to obtain confidence that the licensee has comprehensively and accurately identified the potential for solvent accumulation, that the Operating Instruction accurately reflects these locations and that the monitoring required by the Operating Instructions is adequate. Careful consideration should be given to any licensee recovery plans. |
| 1. Is the licensee adequately controlling fire loadings in fissile material areas i.e., preventing accumulations of flammable materials? | It is a general expectation that the licensee will minimise fire loadings across its plant (i.e., not only in fissile material areas), but the presence of any combustibles should also be kept as low as reasonably practicable (i.e. the minimum in line with process requirements). Electrical equipment should be routinely tested and maintained, and cabling should be frequently inspected. Any redundant electrical equipment should be promptly removed to prevent the potential for it being re-energised by mistake in the future. Any items to be installed on plant (even commercial off-the shelf items) should be scrutinised by the licensee’s electrical experts (within the licensee’s established LC 22 process) i.e., to ensure they do not pose any elevated fire risk once installed on the plant.  Plant areas should not be used, even temporarily, for the storage of flammable materials and the licensee should have established and documented routines in place for frequent walk-downs to be conducted of the plant to ensure poor housekeeping is promptly addressed (particularly after periods of plant maintenance and/or modification).  In areas where fissile material is present the licensee’s CCCs/point of work instructions should be clear with respect to how any fires, occurring in such areas, should be fought (i.e., to minimise the potential for moderators to come into contact with fissile material). Both the operators and any on site firefighting capability should be conversant with the firefighting requirements in such areas. | The ONR inspector should undertake a general plant walk-down but should pay attention to a sample of criticality stations to ensure a good standard of housekeeping is being maintained and to ensure the licensee is minimising the presence of flammable materials in line with the minimum process requirements. The licensee should be asked to justify any flammable materials observed on the criticality stations.  The logs of the routine plant walk-downs should be examined, to ensure the walk-downs are being conducted as required and at a reasonable periodicity. Findings from the walk-downs should be documented along with any actions to address adverse findings. The licensee should be able to demonstrate that any such actions are promptly closed out. The licensee should also be able to articulate and demonstrate a clear policy for enhanced plant walk-down immediately following periods of maintenance or plant modification (again documentary evidence of the conduct of such inspections should be sought from the licensee).  Engagement with plant operators should ensure that they are conversant with the requirements to maintain adequate levels of plant housekeeping and can explain the firefighting requirements in fissile material areas. |
| 1. Where the licensee’s criticality assessors have specified the use of specific firefighting equipment in fissile material areas, are the required firefighting appliances present – e.g., dry powders and CO2? | The licensee’s criticality safety assessments should establish the optimum method of fighting fires, in all fissile material areas, so as to ensure that firefighting minimises the risk of occurrence of criticality to as low as reasonably practicable (e.g., by the use of powder or CO2 etc.). It is expected that the licensee will have rated fissile material areas in terms of the risk of occurrence of criticality, should liquid moderator be introduced (e.g., high, medium, low). For high-risk areas it is expected that the licensee will have restricted the use of water-based fire extinguishers in the event of a fire.  However, in all cases the use of water for firefighting will still be permitted when the Chief Fire Officer deems that the risk posed by the fire outweighs that of occurrence of criticality.  Information, on firefighting requirements for different fissile material areas, should be made readily available to plant operators and the on-site and off-site emergency services (with commercial or information security considerations considered). Practice drills should routinely be conducted.  The licensee should conduct routine documented inspections to ensure that where firefighting is restricted to the use of particular types of extinguishers then these have been provided and are routinely maintained. Checks should also be made to ensure that prohibited types of firefighting appliance are not present in the fissile material areas. | The ONR inspector should sample the plant’s ‘fire plan’ (with the support of an ONR fire safety specialist inspector if necessary) to ensure that the firefighting plan aligns with the requirements of the licensee’s criticality safety assessment.  The inspector should engage with the plant operators to ensure they are fully conversant with the firefighting requirements of the fissile material areas in which they are working.  Firefighting appliances should be sampled within the fissile material areas, to ensure those present are as per the requirements of the criticality assessment and are in date.  The inspector should seek evidence that the licensee routinely works with the local on-site and off-site Fire Brigades to inform them of the firefighting requirements in fissile material areas and to ensure that these arrangements are routinely exercised.  The inspector may wish to seek further information as to how the Chief Fire Officer would come to any decision that the risks posed by the fire merit the use of water for fire-fighting purposes (i.e., what information would feed into such a decision, with whom would the Chief Fire Officer consult before authorising the use of water and how would such decisions be recorded and where)? |

# Appendix 10 – Licence Condition 25: Operational Records

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| **Licensee Arrangements**   1. Does the plant maintain operational records? If so, what records are kept by the plant to show that the operations are maintained within the safe operating envelope? 2. Do the records fully support the safety case? Are all operations adequately covered? Are there any gaps or ambiguities? 3. Are the records kept for an appropriate period of time? What is this period, and can it be justified? 4. Is the record system accessible, reliable, and secure? 5. Are record-keeping duties formally defined? 6. Are there appropriate checks on data entry? 7. Is the system for recording fissile material mass discrepancies adequate?   **Implementation of Arrangements**   1. Are those responsible for maintaining the records formally identified and SQEP? 2. Are the records robust (e.g., appropriate checked, and signed, with dates and times)? Are the records self-consistent? 3. Is there a formal handover at shift-change to alert the new shift of potential problems (e.g., data anomalies)? | Every plant should maintain records. These should be available for inspection. The nature and extent of these records will depend on the plant, but there should be a clear “line-of-sight” between each of the operational records and each of the outputs of the licensee’s plant safety case (i.e., limits and conditions and safety mechanisms devices and circuits, SMDC and their performance requirements and operator actions).  Records may be paper or computer-based as appropriate but should be subjected to suitable back-up and retention arrangements (i.e., as per the requirements of LC 6). The licensee should be able to demonstrate that the records system is easily accessible by those needing to access this system but is also secure against unauthorised access.  ONR expects that the arrangements for record keeping will cover all aspects of criticality safety, including:   * The design of operations and plant, * The criticality assessment of operations (including checking and approval), * Import, export and change of form of all materials important to criticality safety (i.e., fissile, moderating and restricted materials), * Calibration, maintenance and repair of plant items important to criticality safety, * Plant modifications. * Staff training and experience.   Unless the inspection is a ‘deep dive’, or there are specific concerns, the expectation is that only a small number of these areas would normally be sampled in an inspection.  Typically, depending on the plant and from a criticality safety perspective, there should be records maintained by the licensee of:   * Locations, types, masses and/or volumes of fissile, moderating, and restricted materials that are handled in the plant. Errors in these values and data uncertainties should be demonstrably accounted for by the licensee, * Records of changes of form of fissile material e.g., due to the conduct of processes in the plant, * Values of fissile Material Unaccounted For (MUF) by criticality station and data from criticality station clean-out operations (material masses recovered), * Maintenance and calibration records for equipment of importance to criticality safety e.g., balances and measurement equipment (e.g., concentration monitors, acidity monitors and sump monitors), * Equipment status and configuration. * Records of CWS activation. * The results of integrity checks for vessels and shielding (this may include radiographs, measurement results, photographs, fibre optic camera footage etc.), * Lists of vessels installed on the plant and containers present on the plant, * Logs of Operator actions during fissile material operations and moves (i.e., showing who did what, with the date and time), * Internal plant inspections (this may include radiometric measurements, photographs, logbooks etc.), * Details of any plant modifications, * Abnormal events of a direct relevance to criticality safety (e.g., fissile move errors), or which could impinge upon criticality safety (e.g., the presence of an incorrect container type for storage of fissile material), records of investigations, key findings and actions taken, * Lists of all the extant CCCs/point of work instructions applicable to the licensed site, their review dates and posted locations on plant, * Lists of any temporary CCCs/point of work instructions, their on plant locations and their validity dates, * Reports of the findings of criticality safety walk-downs, conducted by the licensee’s criticality professionals and/or ‘criticality specialists’, senior managers etc. * Evidence of closure of any actions emerging from criticality safety walk-downs/inspections etc. conducted by the licensee, * Lists of criticality stations and up to date drawings of the locations/extent of such stations, * Movement control records for all moves between criticality stations involving fissile materials, * Copies of extant and historical criticality safety assessments for all fissile operations presently/previously conducted by the licensee, * Copies of Peer Review/QA activities conducted on licensee’s criticality safety assessments, * Locations of criticality incident detectors and assessments demonstrating that the current positioning of criticality incident detection heads meets the requirement to be able to detect the licensee’s defined ‘minimum incident of concern’, * Criticality awareness training/refresher training records for both criticality professionals/SQEPs and for fissile plant operators, supervisors, managers and DAPs (recognising that the depth of the training may vary depending on the role), * Criticality training materials, * Drawings of the location of all criticality-related signage within/outside the licensee’s plant(s) and its maintenance/inspection records. * Criticality exercise records, including records of review, learn and improve (RLI) exercises. * SQEP records for criticality safety staff. | Compliance with LC 25 ensures that the licensee records significant events on the plant, documents its checks made on safety related parameters and plant configuration, details the outcomes of plant inspections and records the work that has been carried out to repair, service or refurbish plant systems and equipment.  The advice in this section has been taken from NS-INSP-GD-026 but has been tailored for criticality safety.  Note that:   * Records of fissile material holdings are also required to demonstrate compliance with LC 4 (Restrictions on Nuclear Matter on the Site) and LC5 (Consignment of Nuclear Matter). * LC25 (3) & (4) empower ONR to specify that additional records be kept by the licensee and for the licensee to provide copies of extracts from such records that ONR may require. * There are generally uncertainties inherent in the measurement and recording of fissile masses. These should have been identified and accounted for in the licensee’s record system.   It is recommended that the ONR inspector samples from a number of the plant records, pertaining to criticality safety (e.g., from the list provided in the previous column). These records should be clear, legible, up to date, contain relevant signatures where required etc. Ideally cross-checking between records should be conducted where possible to ensure records are consistent and accurate.  The inspector may wish to review a number of historical plant records i.e., to ensure the licensee is adequately maintaining its historical records.  The ONR inspector should also seek information on record keeping between shifts and the requirements for shift handovers to ensure that a robust process is in place to ensure continuity of record keeping. |

# Appendix 11 – Licence Condition 26: Control and Supervision of Operations

## Criticality Safety Team

ONR accept that in order to phrase the questions in this section, some assumptions have been made about the make-up of a licensee’s criticality team structure and team management structure. In addition, it is recognised and accepted that some aspects may be carried out by a plant facing safety case team function at some licensees (rather than criticality specialists). In pursuing questions from this section, the ONR inspector should hence be cognisant of a particular licensee’s arrangements and organisation and hence may need to slightly modify some of the questions to address differences from the model assumed in the questions below.

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. For its criticality safety assessment function, has the licensee defined and justified the minimum numbers of staff required for each of the defined roles within this function (including management and supervision roles)? 2. Has the licensee formally defined what is required to achieve SQEP status in each of the defined roles within the criticality safety specialism? 3. Is there a training plan in place for each member of the licensee’s criticality safety team to ensure SQEP personnel fill each defined role and that this can be maintained? 4. Is the licensee’s criticality safety team resilient to staff loss? 5. Do the numbers of staff in post meet the defined requirements (i.e., the licensee’s baseline)? 6. Are all defined posts/functions within the criticality safety group filled? 7. For the criticality safety team, are all of the training records and SQEP appointment letters in date? | The purpose of LC 26 is to ensure that the licensee maintains responsibility for and control over, the day-to -day activities (i.e., operations as defined in LC 1) on its site which may impact on nuclear safety. This should generally be exercised through supervision by suitably qualified and experienced persons (“SQEP”s) following formal procedures.  For its criticality safety team, the licensee should be able to provide documented evidence that it has formally defined each of the individual roles within this specialist team (including the more senior management and supervision roles). The number of personnel required in each role should also be defined and justified (and should be reviewed routinely, recognising that the licensee’s criticality safety workload may increase or decrease over time). The licensee should be able to demonstrate it has sufficient SQEP personnel to meet its defined baseline requirements or has credible plans in place to address any shortfalls.  For each defined role the key training /knowledge/experience requirements should be defined and documented, and training plans should be in place to ensure that individuals can be SQEP’d into the roles.  It is ONR’s expectation that on attainment of the appropriate level of knowledge/experience (some of which is likely to be delivered by training and some via on-the-job experience, mentoring etc.) then persons will be appointed as SQEP, to the various criticality safety team roles, through a formal documented process.  The licensee should also be able to demonstrate that suitable succession planning is in place to address its normally observed ‘churn’ of staff, the requirement to continue to develop its criticality safety staff towards more senior roles and to address any age demographic. | The ONR inspector should endeavour to sample from a number of areas, identified in the previous two columns, including:   * Ensuring the licensee has an adequate and suitably trained and experienced criticality safety assessment function. (The inspector may wish to seek ONR criticality safety assessment specialist advice when sampling in this area). * Ensuring the licensee is demonstrating adequate management of any contract criticality safety assessment resource employed by the licensee. (Adequate discharge of Intelligent Customer responsibilities by the licensee).   It is recognised that many licensees employ contract criticality assessors, usually to ‘smooth’ peaks and troughs in assessment workload but it is of importance that the licensee maintains an adequate Intelligent Customer capability in order to be able to adequately supervise this contract labour force and to ensure that the licensee does not lose technical competence, plant knowledge and experience etc. |
| The following questions are pertinent the licensee’s use of contract criticality assessors:   1. What is the licensee’s mix of its in-house criticality safety assessors to contract labour and how has the licensee assessed and demonstrated its ability to adequately manage and supervise its contract criticality assessor workforce i.e., how does the licensee discharge its ‘Intelligent Customer’ requirements? 2. Does there appear to be any over-reliance on the use of a contract assessor workforce and has the licensee any credible plans to address any such situation encountered? | Where the licensee is using contract staff to supplement its defined criticality safety baseline, the licensee should be able to demonstrate:   * How the contract staff are supervised and managed (situations where contractors are managing other contractors should be avoided). * How the licensee is monitoring and ensuring it is not losing key expertise e.g., technical knowledge of its plant and processes and key criticality assessment skills. (This could be addressed, for example, by ensuring a rotation of in-house staff and contractors around the different criticality work areas – i.e., it would be inadvisable to have a contractor become the licensee’s ‘expert’ for any specific criticality safety role). |  |
| 1. Has the licensee adequately defined and documented the roles and responsibilities of criticality safety staff tasked with supervising contractors? 2. When choosing contract staff to execute criticality safety work, how does the licensee assure itself that its contractors are SQEP for the particular task(s) they wish the individuals to undertake and how is this process documented? 3. What quality assurance is applied to the work of contract criticality assessors i.e., does the work proceed through the licensee’s own QA arrangements, or is the contractor tasked with applying the contractor organisation QA to the work undertaken by its staff? 4. If contractor QA arrangements are used, then what scrutiny does the licensee exercise over the adequacy of the contractor’s arrangements and how can the licensee demonstrate the application of this scrutiny? | * The licensee should be able to credibly demonstrate that no over-reliance is being placed upon a contractor workforce and that it is routinely reviewing its staff to contractor workforce balance. * The licensee should document how it has chosen particular contractors and what process it has undertaken to ensure that the chosen contractor is fully SQEP for the work he/she has been appointed to do. There should be clarity of the standards the individual contractors are being measured against, which ideally should mirror the training/experience requirements expected of the licensee’s own staff for a particular role. * The licensee should be able to demonstrate it is monitoring and reviewing the performance of each of its contractors and is actively managing this to ensure the licensee’s own assessment standards are met and maintained by its contractors. * It would be ONR’s expectation that the licensee’s contractors work to the licensee’s own defined and documented QA standards e.g., for checking, QA, and approval of its assessments. The licensee would be expected to justify any deviation from this expectation.   The licensee may wish to designate a small number of its more experienced personnel to supervise its contract workforce but should recognise that supervision should not be limited to financial supervision; active technical supervision is also required. It may also be appropriate that the licensee personnel undertaking the role are provided with specific training in the role and the licensee may wish to discuss with its training professionals what such training would typically be expected to contain. | See previous page. |

## Criticality Control and Supervision on Plant

| Question | ONR Expectations | Additional Comments |
| --- | --- | --- |
| 1. Is there a formal system in place to define the responsibilities of:  * Managers with operational responsibilities? * On-plant safety advisors? * On plant criticality safety advisors (if this role is utilised by the licensee)? * All staff in an operational supervisory capacity? * Staff issuing permits to work, work packages etc. * What supervision and monitoring of the operators on the plant is undertaken by the management? * Is support from SQEP criticality safety staff readily and promptly available to the operations staff of the facility? | **On Plant Criticality Control**  For the maintenance of criticality safety, the primary concerns centre around the control of fissile, moderating and sometimes neutron absorbing materials.  The controls are there to ensure that the form, mass or volume and/or concentration and/or geometry of these materials remain in a safe combination. The accurate and consistent implementation of these controls will depend upon the training and understanding of the plant operators and their management and supervision i.e., to ensure that they are conducting operations safely and as per the Operating Instructions and CCCs/point of work instructions. | The inspector should seek top sample from an number of areas in the previous two columns, for example:   * The licensee has defined clear roles and responsibilities for all staff engaged in fissile material operations on the plant (including supervisory roles). * The licensee can provide a demonstration of the training requirements for all on-plant fissile material roles and clear evidence that on plant personnel have been SQEP’d against these roles. * The licensee can demonstrate the presence of personnel tasked with ensuring the accuracy of fissile material moves and control of fissile material on the plant.   There is evidence of the presence of an ‘open’ criticality safety culture on the plant.   * The licensee can evidence the conduct of routine and thorough criticality safety walk-downs on the plant and the discharge of prompt and targeted actions to address any adverse findings.   The licensee can demonstrate the accurate completion of criticality safety related documentation on the plant and the arrangements for retention of such completed documentation as plant records. |
| 1. Is there a Nuclear Material Controller(s) – or similar role -identified and trained who confirms beforehand that the movement of fissile material from one location to another meets the requirements of the Criticality Clearance Certificate/point of work instruction for the destination station and any intermediate criticality stations? 2. Does the safety culture on the plant enable workers to talk to their supervisors regarding potential ‘work-arounds’ with respect to Operating Instructions and would the Supervisors in turn take these ‘work-arounds’ to criticality experts to see if they genuinely represent a better method of working? 3. Are routine walk-down criticality safety audits undertaken by management/the licensee’s criticality safety professionals? 4. Are such routine walk-downs conducted to a defined instruction? 5. How are any adverse findings from plant walk-downs dealt with (e.g., are appropriate Actions defined, assigned unambiguously and are these Actions then suitably closed out)? 6. Do Actions placed from criticality safety walk-downs have sufficient visibility with the licensee’s senior management i.e., are management aware of the walk-down findings and can it be demonstrated that they actively track Action closure? 7. Are there systems in place to report and record accidents and abnormal events? Is there evidence available to show that these are being used? 8. Are there working instructions to define/control all operations with fissile material? 9. Are there sign-off sheets to give assurance that work has been properly executed and checked? Have these been appropriately completed and signed and are these suitably treated as plant records and retained/stored? 10. Are all staff conducting operations with fissile material demonstrably SQEP for the tasks they are conducting? 11. Are contractors involved in operations and if so, are they properly trained, accredited SQEP and supervised? 12. Is there an overall work-planning system and has this been implemented? 13. Does the licensee encourage any external audit of their criticality arrangements e.g., by their internal regulator, or by criticality safety personnel from other licensee sites/facilities? 14. How often are such audits undertaken and how are the findings/Actions etc. recorded? 15. Are all fissile material stores adequately controlled (i.e., locked when not in use and supervised when in use)? 16. If moderating or other restricted materials are required in the process, are they controlled and is this control documented? 17. Is safety related information (e.g., extant CCCs/point of work instructions) available at the workface? | The licensee should be able to demonstrate that its staff (operators, managers, supervisors etc. engaged directly in operations with fissile material) will be able to demonstrate a good awareness of the risks posed by criticality, the plant controls maintaining criticality control and the demands placed upon them by these controls. Plant personnel should have a good working knowledge of the key factors affecting criticality safety.  All licensee staff engaged in operations with fissile material (including supervisory staff) should have clearly defined roles and responsibilities, with clear associated training profiles that the licensee can demonstrate its staff have been defined as SQEPed against.  The licensee should be able to explain and justify the level of supervision it exercises over fissile material operations on the plant and evidence should be available that supervisors, managers etc. witness (and sign off against) any key steps in fissile material processes or moves.  A role conducting independent checks of fissile material moves on plant is of importance i.e., in checking that no such move(s) will breach any of the established CCC/point of work instruction fissile limits at criticality stations. The licensee should be able to explain the responsibilities of such staff and the training they have received for the conduct of their roles.  Contractors working on the plant should be trained to an equivalent level to that of the licensee’s staff and should function as an integral part of the licensee’s team. Supervision of such staff should be as least as diligent as for the licensee’s own staff.  The safety culture on the plant should be demonstrably a good and open culture with operators actively encouraged to raise/discuss issues with their managers and supervisors and with clear evidence that such concerns are listened to, explored and actions are taken to address them where required (with appropriate feedback loops to personnel raising such concerns).  Routine criticality safety walk-downs of fissile material plant should be conducted, at an appropriate periodicity, to an established procedure/check list. The findings should be documented, and any adverse findings should be recorded with clear actions/responsibilities to address these being identified. It is expected that the licensee will be able to adequately demonstrate that all actions arising from such inspections have been appropriately closed out. The licensee should also be able to demonstrate that senior managers take an active interest in the conduct of such inspections, in their findings and in ensuring that actions required to address adverse findings have been satisfactorily closed.  It may also be appropriate that the licensee’s own internal regulator be involved in at least sampling the conduct of some of these plant walk-downs.  Plant records should be readily available at the point of work that indicate that key checks, required for fissile material control, have been made and signed off accurately at the appropriate levels. The licensee should be able to demonstrate appropriate documentation retention systems for these plant records.  Control of all fissile material stores should be in place and implemented on the plant by the licensee. |  |

# Appendix 12 – Licence Condition 27: Safety Devices, Mechanisms and Circuits

## Favourable Geometry i.e., Safe by Shape Plant Items

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| Question | ONR Expectations | Additional Comments |
| 1. What items of plant are important in maintaining criticality safety (e.g., vessels, containers of fissile material, pipes, and sumps)? 2. Are fissile material containers, vessels, pipework etc. of a geometrically favourable design i.e., assessed to be sub-critical for a range of plant conditions including credible faults that can occur? Plant events which have a potential to alter/affect the installed/designed geometry of such items (e.g., drops, impacts and corrosion, i.e., which could move them towards an unsafe geometry) should be considered by the licensee within the plant safety case and the potential consequences should be analysed. The physical condition of such items on the plant should be routinely monitored to ensure no adverse changes to the geometry of such plant items have occurred. 3. If plant modifications are made to vessels, pipework etc. or additional fissile material containers of a geometrically favourable design, have to be imported into a criticality station(s) then what procedures control these modifications to ensure the new plant/equipment meets the relevant geometric constraints? | There should be a list of all items important to criticality safety. This should derive from a safety case, together with:   * A precise description of the performance requirement of the item (i.e., its safety function), * An indication of how important each item is (i.e., its class), * There should be links to documents defining maintenance/inspection schedules and substitution arrangements for all such items that are key to the maintenance of criticality safety on the plant, * The licensee should be able to demonstrate that where a plant item is designed to be of a favourable geometry then its condition is frequently checked to ensure that its geometry has not been compromised, * Wherever practicable, fissile materials should be processed, stored, and transported in containers which, because of their geometry (e.g., depth, radius or volume), are incapable of supporting a neutron chain reaction. Account should be taken of neutron reflection and interaction, and credible abnormal conditions in the design of such containers. | The plant operators, supervisors etc. should accurately understand and be able to articulate all plant items that provide a passive (favourable geometry) role in delivering criticality safety on the plant and how these items are inspected/maintained to ensure they continue to deliver their safety function.  [Geometrically safe (or favourable geometry) containers are those which are incapable of supporting a criticality, generally for a specified set of materials and under defined conditions].  In assessing the adequacy of a licensee’s arrangements judgement is needed because a number of factors are relevant, such as: operability; credible concentration ranges under both normal and credible abnormal conditions; and also, other safety concerns, such as maintainability and operator dose.  As ever, an important principle to keep in mind is ALARP, i.e., reducing the total risk from all sources as low as reasonably practicable.  The inspector may wish to sample the physical condition, on plant, of a number of items claimed by the safety case to be safe by shape. |
| 1. Are the maximum safe concentrations for geometrically favourable containers known and can they credibly be reached? If so, what additional controls are in place to prevent this from happening? | There should be documentary evidence available for inspection as to the extent of this favourability. ONR would expect the documents to address:   * The working, safe and critical fissile material concentrations (i.e., Limits and Conditions). * Reliable mechanisms for revealing unsafe concentrations. * Means to prevent a critical accumulation.   Additionally, evidence should be available to show that controls (and any limitations) are understood by plant (e.g., training materials and records).  All documentation should be readily available, be in-date and show evidence of adequate QA. | The licensee’s LC 22 process should also be sampled and shown to be robust in ensuring that criticality safety advice is obtained for any modifications to fissile material plant, such that safe by shape items are not inadvertently adversely modified and/or non-safe by shape items are introduced (e.g., fissile material containers).  Many of the questions and expectations in this Appendix apply to any container containing fissile material (e.g., waste drums) because credit will probably be taken in the safety case for dimensions and material specifications.  Items to be considered include, but are not limited to:   * Balances (scales), * Neutron monitors, * Computer based systems for tracking fissile material moves.   All deliver an active criticality control function on the plant and the ONR inspector should seek more information to ensure these are calibrated, inspected etc. at an appropriate periodicity. Any adverse findings during maintenance should be documented and promptly rectified. |

## Substitution Arrangements

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| Question | ONR Expectations | Additional Comments |
| 1. Where a criticality control on a process is provided by an engineered control e.g., an instrument or a device, then occasionally this has to be removed (e.g., for maintenance). The safety case will often allow this control to be substituted for another control during the interim period. Is the process adequate?   ONR notes that this question applies equally to outages where again there may be a requirement to substitute the criticality control during the outage and once again adequate controls must be in place to robustly control the plant’s return to its normal configuration post outage. | There should be a process in place to control both the initial substitution and the return of the plant to its original condition, to ensure that these processes are robust and that plant personnel will, at all times, be completely clear as to what devices/systems are providing the criticality safety protection. | “ALARP” considerations are appropriate: Substitution arrangements may not be as rigorous or effective as the duty arrangement but may be appropriate when other factors (e.g., cost, operability, and dose) are taken into account.  It may be advantageous to solicit advice from inspectors from other ONR specialisms as to the adequacy of the licensee’s arrangements. |

## Neutron Absorbers

| Question | ONR Expectations | Additional Comments |
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| 1. Are any neutron absorbers present? If so, then can the licensee justify the absorber chosen taking into account such factors as: the environment in which they will be located (e.g. considering physical/chemical/radiation field factors in this environment), ageing/degradation of the absorbers over the process lifetime and ease of replacement if required, ease of testing, maintainability etc.? 2. Are there physical gaps in the neutron absorbing structures (e.g., at the top or bottom of the structures) that could result in a reduction of safety margins in accident conditions? 3. When a neutron absorbing device, to be used for criticality safety control, first arrives at a licensee’s site from an external supplier/manufacturer, how does the licensee convince themselves that the device has been supplied as originally specified e.g., does the licensee conduct any testing on the device? 4. Alternatively, does the licensee place a total reliance on the QA documentation shipped with the item? 5. If a plant item containing neutron-absorbing structures for criticality control purposes, is dismantled e.g., for inspection or maintenance, then what procedures does the licensee have in place to ensure that when the plant item is re-assembled, the neutron-absorbing structures are re-introduced in the correct position and the proper orientation? What checking/sign off of disassembly/reassembly is conducted? What records are kept of the process? 6. How are the disassembled neutron-absorbing structures protected after removal from the plant/equipment? 7. Are all plant items containing neutron-absorbing structures for criticality control purposes clearly labelled? | There should be recognition of the physical/chemical/radiation environments within which neutron absorbing structures i.e., for criticality control purposes are sometimes present and that these environments could lead to a degradation of neutron absorbing structures with time, such that their neutron absorbing effectiveness decreases. In any such circumstances (more information can be supplied by ONR criticality specialist inspectors), the inspector should expect to see routine Non-Destructive Assay (NDA) activities to ensure the required degree of neutron poisoning remains in place with time. Such NDA work should be designed/specified by the licensee in association with appropriate experts in the field. Records of each such inspection should be kept.  ONR would expect that the licensee will maintain documentary evidence (which should be sought from the licensee and sampled by the ONR inspector) of any licensee testing claimed for its procured neutron absorbing materials. Advice should be sought from an appropriate ONR specialist as to the likely accuracy of the technique employed.  If reliance is placed on QA paperwork, then ONR would expect that the licensee has independently inspected the manufacturer’s facilities and obtained sufficient confidence in the QA controls applied by the manufacturer. The licensee should be able to provide evidence to confirm such audits have been conducted by appropriate QA experts from within the licensee’s organisation.  In cases where soluble neutron poisons are used for criticality control, it is expected that appropriate checks and measurements will be used to, so far as is practicable, to confirm the neutron poison is present at the correct concentration and is homogeneously distributed within the liquid system. The licensee should be able to demonstrate that its procedure for re-establishing the neutron poisoning in the system, e.g., following plant shut-down/wash-out, contains appropriate check and balance steps and requires sign off by appropriate senior plant personnel/managers and subject matter experts.  All neutron-absorbing structures, used for criticality safety control, should be clearly labelled and identified and these labels/identifying marks should be clear and maintained in good condition throughout the operational lifetime of the structure. It is expected that where neutron-absorbing structures have to periodically be dismantled – e.g., for maintenance or inspection, the licensee’s procedures/instructions for reassembly will clearly identify as key steps the reassembly of the neutron-absorbing structures themselves. Such key steps would be expected to have checks and sign offs by senior engineers/criticality safety professionals/managers signifying that the structures have been reassembled correctly. Records should be retained (as per LC 6) of all such disassembly/reassembly tasks.  Suitable provision should be made for protecting the neutron absorbing structures from damage (e.g., impacts, drops and chemical damage) when they have been removed from the plant e.g., purpose-built storage racks and dedicated storage areas. It is expected that part of the reassembly procedures will include visual and dimensional checks to ensure that the structures have not been damaged during the period in which they were removed from the plant. It may also be necessary to conduct confirmatory checks to confirm the neutron absorption properties remain as per the original safety case intention. | Neutron absorbers (e.g., Cd, Hf, Gd, B) are used extensively throughout the industry to maintain criticality safety, e.g., in fuel ponds, transport flasks and in reprocessing.  In neutron assay the presence, loss, degradation or absence of poisons could affect the readings. Neutron absorbers may be significantly important to the safety case.  In a “flux trap” (e.g., as commonly found in transport flask design), the neutron absorbers need to be associated with a specific width of flux trap in order to function properly.  There have been many examples in the nuclear industry of problems with neutron absorbers, e.g.: never actually being present; QA records lost, so that their absorber content is unknown; loss through degradation; incorrectly configured in a flux trap and moderator omitted or degraded in the flux trap.  Given the problems over the years from degradation or loss of neutron absorbers, periodic verification that the neutron absorber fully meets the requirements of the relevant safety case is required. There should be recognition, and assessment by the licensee, if needed, of the physical/chemical environments within which the neutron absorbing structures are operating.  It should be noted that accidents (fire, impacts etc.) may cause neutron flux gaps to widen causing a significant increase in reactivity.  The ONR inspector should seek to sample the licensee’s procedures; checks etc. for ensuring the correct level of soluble neutron poisons are present in the process.  In assessing the effectiveness of licensee arrangements with respect to neutron-absorbers used for criticality control, the ONR inspector may need the assistance from ONR inspectors from other specialisms (e.g., Control and Instrumentation and Mechanical Engineering).  It is likely that the ONR inspector will wish to obtain confidence in the licensee’s careful control of any neutron-absorbing structures for on-plant criticality control e.g., by sampling records of previous dismantling/reassembly operations, looking at working instructions, or viewing storage areas for such structures. |

## Criticality Warning Systems (CWS)

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| Question | ONR Expectations | Additional Comments |
| 1. Is the area in which fissile material operations are taking place subject to a Criticality Warning System (CWS)? If not, the inspector may wish to ask to see the licensee’s documented CWS Omission argument. 2. If an area is subject to CWS coverage, then do the workers know what actions to take if the system’s ‘clip clop’ warning tone were to cease? The inspector may wish to sample the worker’s knowledge in this area. 3. Similarly, if a CWS only is installed do the operators know the actions to take if this system raises an alarm? 4. Where are the required operator responses laid down and how accessible are these to the operators? How have the operators been trained in the required responses? 5. For a site with multiple plants, the inspector may wish to check that the operator response to CWS failure is standardised across all plants. 6. Has the CWS been designed in accordance with modern standards? | ONR’s expectation is for one of the following:   * A CWS omission case, if appropriate, * A properly designed, tested, operated, and maintained CWS, * A system which can act as a CWS where a full system is not practicable (which should be justified by the licensee) for example temporary gamma and/or neutron monitors installed close to a workface.   The CWS should be designed, tested, maintained, and operated in accordance with international and national guidance on this subject. CWS should meet this national/international guidance as so far as reasonably practicable.  CWS Omission cases should be written to the national guidance on this subject.  NS-TAST-GD-018, “*Criticality Warning Systems*” provides guidance on all of these topics.  The licensee should have clear and documented procedures in place defining the actions to be taken should the CWS system fail during plant operations (or if the installed CWS system were to raise an alarm). All on-plant personnel should be trained in these procedures and should be able to clearly articulate them. The documented procedures should also be readily accessible on the plant.  Generally, CWS responses should be standardised across all of the licensee’s fissile material plants. For any situations where this is not the case, the licensee should be able to articulate why this is not the case and provide documentary evidence of the analysis it has undertaken in coming to a requirement for a different response. | If the CWS fails during the conduct of fissile material operations, then the normal action expected of the operators would be to cease operations in the plant, especially those involving fissile material.  However, if stopping a specific operation could increase the criticality risk (e.g., in nuclear chemical plants) then it may be reasonable for such operations to continue but with increased vigilance until the recovery plan is implemented. The licensee should be able to supply evidence to support its chosen strategy which shows that an appropriate balance of risks has been achieved.  In some plants, the requirements of criticality emergency response may conflict with other concerns (e.g., security). The inspector may wish to check that a sensible balance has been achieved.  The ONR inspector should engage with a sample of on-plant personnel to obtain confidence in their degree of knowledge of the emergency procedures in the event of failure of the CWS system during on-plant operations (or of the operation of the CWS – e.g., the raising of an alarm by the CWS system). The inspector may also wish to be reassured that plant personnel receive routine training updates against these procedures.  The ONR inspector may wish to sample CWS responses across a number of the licensee’s fissile material facilities and to question any areas where a non-standard approach/response is required.  Advice should be sought from ONR criticality and C&I specialists in ensuring that the licensee’s CWS systems are in accord with modern design principles or obtain a justification as to why this is not the case.  For older installed systems, focus should be applied to the reliability of the system (e.g., to ensure the system is not generating frequent spurious alarms), the licensee’s ongoing ability to source spares and whether the licensee’s testing, calibration/maintenance routines are appropriate and are re-evaluated at an appropriate periodicity. |

## Mass Balances and Assay

| Question | ONR Expectations | Additional Comments |
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| 1. In facilities where a significant criticality control rests on restricting fissile masses to safe values (e.g., in glove boxes and fuel stores), how is this achieved? 2. Is the accuracy of the devices, used measure fissile mass (e.g., balances and assay machines) adequate to prevent unsafe accumulations of fissile material from developing? [Note – in making judgements with respect to the licensee’s responses in this area the ONR inspector may need to seek specialist advice from other ONR subject matter experts e.g., Control and Instrumentation]. 3. Is the licensee aware of the limitations/weaknesses of the fissile measurement devices it employs and are there appropriate measures in place to deal with these limitations? | Fissile masses should be recorded accurately, so that the mass in a criticality station and indeed the entire facility is known at all times and with an adequate degree of accuracy. The fissile material records should be easily intelligible, up to date and maintained as plant records as per LC 6.  No measurement systems or devices are 100% accurate; this should be acknowledged by the licensee. Accordingly, processes should be in place to mitigate against such inaccuracies. The licensee could (for example) credit any fissile mass discrepancy to the criticality station, or periodically clean the station down. The latter could be done to try to recover any residual fissile material and/or to demonstrate that the missing fissile mass was either an accountancy error or can reasonably be assumed to be ingrained in structures within the glovebox/plant item and hence to be fixed contamination.  Some measurement devices e.g., assay machines, are complicated and may not be sufficiently accurate under some conditions. The licensee should be fully and demonstrably aware of all limitations of its assay equipment and should be adopting suitable error margins in its fissile mass accountancy to account for all known limitations. | The ONR inspector should seek assistance from an ONR criticality safety specialist (and other specialists as required – e.g., specialists in instrumentation) to sample the licensee’s systems for controlling on-plant fissile material masses, to ensure that the licensee understands the limitations of the methodologies it is employing and to ensure that the licensee has in place suitable mitigations to address any such limitations. |

## Fissile Concentration

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| Question | ONR Expectations | Additional Comments |
| 1. In facilities where significant aspects of criticality control relies on monitoring the concentration of fissile material to safe values (e.g., in vessels, pipework etc.), how is this achieved? 2. Is the accuracy of the devices used to measure fissile concentration (e.g., neutron monitors, mass spectrometry sampling etc.) adequate to prevent unsafe concentrations of fissile material from developing? [When making judgements against the licensee responses in this area the ONR inspector may need to seek advice from other ONR subject matter experts e.g., Control and Instrumentation]. 3. Is the licensee aware of the limitations/weaknesses of the fissile concentration devices it employs and are there appropriate measures in place to deal with these limitations? | Fissile concentrations should be recorded accurately, so that the concentration in key items of plant are known at all times and with an adequate degree of accuracy. The fissile concentration records should be easily intelligible, up to date and maintained as plant records as per LC 6.  No measurement systems or devices are 100% accurate; this should be acknowledged by the licensee. Accordingly, processes should be in place to mitigate against such inaccuracies e.g., appropriate statistical analysis of those methods used to measure fissile concentration.  Some measurement devices e.g., neutron monitors, are complicated and may not be sufficiently accurate under some conditions. The licensee should be fully and demonstrably aware of all limitations of its equipment and should be adopting suitable error margins in its concentration mass measurements to account for all known limitations. | The ONR inspector should seek assistance from an ONR criticality safety specialist (and other specialists as required – e.g., specialists in instrumentation) to sample the licensee’s systems for controlling on-plant fissile material concentration and to ensure that the licensee understands the limitations of the methodologies it is employing and has in place suitable mitigations to address any such limitations. |

## Systems to deal with Over-Moderation

| Question | ONR Expectations | Additional Comments |
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| 1. Has the licensee identified all sources of water (and other moderators) in the facility? 2. Have the effects of leakages and accumulations of liquid moderator been considered? 3. Will devices employed to detect liquid moderator leakage/ accumulations sound an alarm? Have these been adequately designed and are they adequately maintained? [In making judgements in this area the ONR inspector may need to seek advice from other ONR specialist disciplines as well as referring to any established industry RGP/guidance]. Would operators become immediately aware of the alarms? 4. Have structures important to preventing over-moderation been identified within the licensee’s safety case/on the plant? | The expectation is that a rigorous assessment of all sources of liquid moderator, with the potential to intimately mix with fissile material, under both normal and fault conditions has been carried out by the licensee and is available for inspection. The licensee’s assessment should address what could go wrong on the plant, how badly, with what likelihood, etc. and define measures for prevention and mitigation.  Modern facilities generally have the fault of over-moderation “designed-out” to a greater or lesser extent (e.g., by having buildings which are seismically qualified, the absence of on-plant water lines and the plant design ensuring that only insignificant flooding depths can occur). The licensee should be able to provide evidence of the plant’s design provisions preventing over-moderation, although inspectors may wish to check that no adverse modifications have been made since the initial plant build (i.e., which may have compromised the original design intent). | Historically, common sources of liquid moderator on fissile material plant have included:   * Liquids for clean-down – some may be organic and potentially highly efficient moderators, * Water lines to cooling systems, such as in-box furnaces, * Water lines to heating systems. * Building leaks (roofs, internal drainage pipes), * Topographical flooding, * Floodwater backing up drains etc.   The licensee should be able to demonstrate that all such sources of liquid moderator have been considered within its plant safety case and be able to articulate the mitigating measures (ideally engineered) taken to mitigate against each. The ONR inspector should seek to sample in this area. |

## Fissile Material Movement and Control (FMMC)

| Question | ONR Expectations | Additional Comments |
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| 1. What systems are in place to record the location of and to control the movement of fissile material? 2. What arrangements are in place to give assurance that the system is working properly at all times? 3. Can the licensee provide assurance that simple FMMC errors cannot result in an unsafe condition? | The expectation is that the licensee will have a fully documented description of the systems used in FMMC, including:   * Administrative procedures, * Electronic control aspects * Hardware (e.g., sensors, balances, and gates).   The licensee’s documentation should consider all credible faults (including that of potential data corruption or loss for computer-based systems) and the consequences for criticality safety of occurrence and/or propagation of each of these identified faults. The licensee should be able to clearly demonstrate what mitigating measures are in place and what the residual probability of criticality is with such mitigations in place.  Additionally, the licensee’s FMMC system should contain demonstrable redundancy and diversity, so that failures cannot result in fissile material moves with a potential to erode the margins of criticality safety.  Ideally, in conformance with international guidance (e.g., IAEA SSG-27), the facility will comply with the *Double Contingency Principle,* so that no single erroneous fissile material movement could result in a criticality. | The FMMC system employed by the licensee will depend greatly on the nature of the fissile material facility. For small facilities handling only small amounts of fissile material, then a paper based FMMC system may be entirely appropriate, whilst for large processing facilities containing significant quantities of fissile material, more complex systems may be appropriate (e.g., computerised systems – although the use of a paper-based system, as a back-up and to provide diversity, may also still be appropriate). It is up to the licensee to justify its chosen FMMC system and the ONR inspector should seek advice from other ONR specialists e.g., in criticality, fault studies and human factors, in reaching any judgements as to the adequacy of the licensee’s adopted system(s).  It should be noted that for liquid fissile material systems, fissile accountancy is much more difficult and is likely to require various tests e.g., sampling and measurement devices. It is recommended that the ONR inspector seeks advice from other ONR specialists in judging the adequacy of these systems.  In the case of fissile waste systems, accountancy is likely to rely upon assay systems. Such systems can be very complicated and may have limited accuracy and range. The inspector is advised to seek ONR specialist advice when inspecting such systems.  ONR expects that all potential FMMCS errors be assessed within the licensee’s safety case as potential initiating events for faults and the licensee should be able to provide this assurance in its safety case documentation. |

# Appendix 13 – Licence Condition 28: Examination, Inspection, Maintenance and Testing

## Maintenance and Calibration

| Question | ONR Expectations | Additional Comments |
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| 1. What equipment is important to criticality safety and is there a maintenance schedule for these items? 2. Is all calibration and maintenance undertaken by SQEP personnel and how can the licensee demonstrate this? | The licensee should maintain a comprehensive list of all equipment important to criticality safety (for examples see list in next column, the list is not intended to be definitive).   * The list should be derived from the licensee’s criticality safety cases for each of its processes or plants and should include:   + A precise description of the performance requirement of each piece of equipment identified (i.e., safety function),   + A measure of how important each item is in delivering criticality safety (i.e., safety class),   + The substitution arrangements for each piece of equipment should it be unavailable e.g., due to equipment failure or routine maintenance,   + Links to documents defining maintenance schedules and substitution arrangements etc.   The licensee should be able to demonstrate, from its maintenance schedule that each piece of equipment identified in the above list has a clear maintenance/inspection/calibration (as required) activity associated with it. In addition, the licensee should be able to justify the periodicity of each defined maintenance/inspection/calibration activity and provide maintenance records to show the required activity has been conducted to this specified periodicity.  The required activities should have demonstrably been conducted by SQEP personnel noting that in some cases, specialist personnel may be required (e.g., for maintenance of complex assay equipment). | A number of different types of instruments are liable to be of importance in ensuring criticality safety e.g.   * Balances, * Concentration meters, * Moisture detectors, * Neutron monitors, * Level gauges and alarms, * Enrichment monitors, * Passive Neutron Coincidence Counters (PNCC), * High Resolution Gamma Spectroscopy (HRGS), * CWS – detectors, sound generators, amplifiers etc. * Computer based systems for tracking fissile material moves.   The inspector should seek information from the licensee regarding key pieces of equipment recognised by the licensee’s criticality safety case as being of importance to criticality safety and should then seek to take a sample of such equipment and to review their maintenance/inspection/calibration routines, maintenance records etc.  There are recognised standards for such systems and their maintenance, calibration etc. and the inspector should seek information from ONR assessors with appropriate expertise in this specialised field, to ensure that the claims made by the licensee in its criticality safety case are valid and substantiated. |
| 1. Following maintenance on criticality safety mechanisms, devices and circuits (SMDC), particularly where these may have been deliberately suppressed and before they are brought back online, are checks/tests conducted which verify the system operational safety functionality as a whole i.e., rather than for instance just a part or parts of it? 2. Are the re-commissioning procedures following maintenance adequate in bringing safety systems back online? | For all criticality related SMDCs the licensee should be able to demonstrate it has robust recommissioning procedures in place, which ONR expects would contain appropriate hold and sign-off points and would need to be witnessed by more senior personnel e.g., DAPs and/or senior plant managers (it may also be appropriate for the licensee’s criticality safety assessors to be involved in witnessing the return to service of such SMDCs). Unless the licensee can justify otherwise, it is expected that ‘end-to-end’ testing of such SMDCs be conducted. All such testing should be accurately recorded, should be fully ‘signed off’ before the plant or process is returned to service and appropriate records should be produced and retained.  At all times the ‘ownership’ of all SMDCs should be clear between maintenance personnel and operational personnel and there should be unambiguous handover arrangements between the two functional groupings at the commencement and end of maintenance/inspection/calibration. Such processes should be accurately documented by the licensee. | The inspector should seek documentary evidence of the licensee’s processes for return to service of SMDCs and then should seek to sample the licensee’s records of recent SMDC testing, prior to return to service. The inspector should also check what processes the licensee uses to ensure unambiguous ‘ownership’ of plant/processes at all times. [Advice from other ONR specialists may be useful in informing the inspector’s judgements e.g., specialist criticality assessors and human factors]. |
| 1. Are calibration/operability checks conducted as per the manufacturer’s advice? If not, why not? | ONR would expect the licensee to have consulted the equipment manufacturer to obtain expert advice on the required maintenance/ inspection/calibration routines for all equipment important to maintaining criticality safety on the plant. However, in some instances the licensee’s own experiences of the equipment may dictate enhanced routines over and above those recommended by the manufacturer (this may become an important consideration as the equipment ages for instance). In all cases the licensee should be able to clearly articulate where its specified maintenance/calibration/inspection activities have come from and how their periodicity has been specified. In addition, the licensee should be able to demonstrate (ideally via documented records) that it routinely conducts reviews of all such activities and their periodicity to test their on-going validity against both their own operational experiences and from wider industry experience. It is expected that any amendments to specified maintenance etc. routines can be justified by the licensee (especially if the licensee has proposed less frequent activities). | The inspector should seek to understand how the licensee has defined its required maintenance/inspection/testing regimes and the periodicity of these activities. Evidence should also be sought that these are routinely re-evaluated. Sampling of the licensee’s maintenance schedule should be conducted for a number of pieces of equipment, key to criticality safety, when inspecting the maintenance tasks and periodicities. |
| 1. Is the calibration sufficiently accurate to ensure that significant differences in the quantity being measured can be distinguished? | It is expected that the licensee fully understands (and has documented) the limitations and errors of any of its equipment used for fissile material assay and hence the limitations of the calibration activities it conducts on such equipment. Suitable error allowances should hence be applied to all fissile assay measurements made by the licensee. The licensee should document how these have been derived and should be able to demonstrate it has taken advice from suitable experts in doing so. | The inspector should ensure that error margins are being applied to the licensee’s fissile assay measurements and that the licensee can adequately justify these error allowances.  Inspectors should note that other items of plant (i.e., not only instruments) may also require consideration as EIMT items. For example, where cranes and other lifting equipment are used to move either fuel, or transport containers loaded with fuel, criticality safety cases may take credit for the reliability of those items, including any interlocks and safety trips. Similarly, other items of fuel handling equipment may provide “active engineered” functions that are important to criticality safety. The licensee should be able to demonstrate that all such items assumed to provide an important function within the criticality safety case have suitable and sufficient maintenance/inspection/testing routines in place and should be able to provide robust evidence that these routines are being adhered to. |

# Appendix 14 – Licence Condition 34: Leakage and Escape of Radioactive Material and Radioactive Waste

## Inspection for Leakage, Accumulation and Loss

| Question | ONR Expectations | Additional Comments |
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| 1. Can the licensee demonstrate that it has adequately considered and documented all possible locations in the process where fissile material could adventitiously accumulate? (e.g., in ventilation ducting, filters, drains, equipment and generally in inaccessible areas – this list is not intended to be exhaustive). 2. Are the licensee’s criticality safety professionals involved in interrogation of data from inspection surveys to look for potential fissile material accumulations and trends? | The licensee should:   * Identify areas where fissile material has the potential to leak and/or accumulate, taking account of any national/international Operational Experience (OPex). * Routinely inspect and survey all of these areas for the presence of fissile material – e.g., by remote camera inspections, radiation measurements, sampling etc. * Record the findings of all such inspections and consider how the fissile material accumulated at that location and how this can be prevented in the future. * For any fissile material accumulations, identified from such routine inspections, the licensee should seek advice from the licensee’s criticality safety professionals as to the significance (from a criticality viewpoint) of the accumulation and to consider how best to retrieve the material so as to maintain criticality safety during retrieval. Where necessary a criticality safety assessment may be required to examine the risk posed by the identified accumulation in its present location and a criticality safety assessment is also likely to be required for the operations to retrieve this material. | * The Inspector should take a view (in consultation with other ONR specialists if required) as to whether such surveys/inspections are being conducted with an adequate frequency, considering all other hazards (e.g., working from height, dose uptake etc.). * The Inspector should ask to see a representative sample of the licensee’s records of surveys/inspections and should look to see that there is no evidence in the records of fissile material accumulation increasing with time. The licensee should be able to demonstrate that it has been taking appropriate advice from SQEP criticality assessors. * The Inspector may choose to walk the process to obtain assurance that the licensee has comprehensively identified all likely locations for fissile material accumulations. |
| 1. If it is credible anywhere on the plant for a fissile solution to leak slowly and evaporate leaving an accumulation of solid fissile material, what visual inspections does the licensee undertake and how often to check for any such leaks and deposits. 2. Have any instrumented means of detecting fissile material leaks (slow and fast) been considered? | The licensee should be able to demonstrate that it is clearly learning from its own plant operational experiences and from elsewhere in identifying all such locations on its plant. Where any potential for slow leaks/accumulations via evaporation exist, it is expected that the licensee will be able to demonstrate that it either has routine inspection/recording activities in place i.e., to visit such locations to ensure no such events are occurring, or it may be appropriate for the licensee to install instrumentation or TV cameras at such locations. The licensee should also be able to articulate (and to have documented) what methods it has considered to monitor for the occurrence of such events and why it has not been able to take any engineered measures to remove the potential for such slow leaks in the first place. The licensee should be able to demonstrate it has adequately considered all such locations and justify the mitigating steps it has put in place to reduce any residual criticality safety risks at all such locations.  The licensee must be able to demonstrate it has evaluated the time it might take to accumulate sufficient fissile material to pose a credible threat to criticality safety and that the measures the licensee has in place to ensure detection of the situation will do so well in advance of any potential for the occurrence of criticality. | The Inspector should seek to explore further with the licensee, any potential for slow fissile bearing liquid leaks and subsequent evaporation, as a potential to lead to fissile material accumulation. It should then be assured that ONR’s expectations (see previous column) have been met and that the licensee can adequately evidence this. |
| 1. Are there any inaccessible locations in the process through which fissile material passes and where there is a potential, e.g., if a pipe/valve were to leak, for fissile material to slowly accumulate over time? What efforts is the licensee taking to obtain evidence that no such accumulations are occurring or have occurred? | The licensee should be able to show that it has given adequate consideration to all locations in its processes/plant where such potential exists and, in all cases, should be able to articulate a credible strategy for investigating such locations further (or be able to demonstrate it has already examined such locations). Again, due consideration should be given to the use of evidence such as:   * Good fissile mass balance across the plant/process (obtained from a robust and reliable accountancy system), * Flow measurements (which might indicate a loss of fissile material bearing liquid), * Radiometric measurements (e.g., of gamma and/or neutrons at the suspected locations), * Camera inspections e.g., via fibre-optic cameras, * Sampling and analysis, * Area radiation monitoring which may indicate a release of fissile material from the process/plant has occurred, * Etc.   [This list is not intended to be exhaustive].  It should be noted that if examination of such a location finds no evidence of accumulation of fissile material, then this does not mean it cannot occur in the future. Accordingly, future examinations should also be planned, especially as the plant and equipment ages.  Additionally, the licensee should consider:  any chemical (e.g., precipitation) or physical (exothermic reactions) that might cause or accelerate leakage. | The Inspector should engage with the licensee to obtain confidence that ONR’s expectations (see previous column) in this area are being met. |

## Leakage Detection

| Question | ONR Expectations | | Additional Comments |
| --- | --- | --- | --- |
| 1. If a fissile solution were to leak, is the area where it would accumulate safe by shape, or can criticality safety be guaranteed by other means? 2. Would all significant leaks be detected and in a timely manner? | The expectations are that the licensee will have formally considered this fault and, if credible, made arrangements to deal with it. Typically:   * the solution would be collected in a geometrically safe vessel or sump, and/or * there will evidence that an accumulation cannot credibly go critical, and/or * the vessel or sump will contain neutron absorbers, and/or * there will be interlocks to terminate the leak, and/or * the time-to-critical is sufficiently long to allow operator intervention to terminate the fault.   Ideally, the process would alert operators to a loss of material before a significant quantity could accumulate. | Areas the ONR Inspector may wish to sample include:   * How exactly would leakage be revealed? * How is fissile material accounted for? Would this accountancy system reveal leakage? * Is leakage to drains or other systems credible? What could happen then? * What about knock-on effects? * Are slow leakages and gradual accumulations of fissile material credible? * Could changes in chemistry due to the leak lead to fissile precipitation or colloid formation? | |