Office for Nuclear Regulation

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Radiological Analysis - Normal Operation			
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1. INTRODUCTION

1.1 The Office for Nuclear Regulation (ONR) has established its Safety Assessment Principles (SAPs) which apply to the assessment by ONR specialist inspectors of safety cases for nuclear facilities that may be operated by potential licensees, existing licensees, or other duty-holders. The principles presented in the SAPs are supported by a suite of guides to further assist ONR's inspectors in their technical assessment work in support of making regulatory judgements and decisions. This technical assessment guide is one of these guides.

2. PURPOSE AND SCOPE

2.1 ONR has the responsibility for regulating the safety of nuclear installations in the United Kingdom. The Safety Assessment Principles (SAPs) for Nuclear Facilities [1] provide a framework to guide decision making in the permissioning process. The SAPs are supported by Technical Assessment Guides (TAGs) that provide guidance on the interpretation of the principles to assist inspectors in the exercise of their professional regulatory judgements about the adequacy of safety submissions.

2.2 This TAG provides guidance on Targets 1 – 3 and the supporting text in paragraphs 712 – 720 [1] that set out numerical criteria in respect of radiation doses to employees and others during normal operation on the site. The background to these targets and an explanation of the associated Basic Safety Levels (BSLs) and Basic Safety Objectives (BSOs) are given in the Explanatory Note on the Numerical Targets and Legal Limits [2].

2.3 Other guidance which is relevant to this TAG is given in T/AST/045 (Radiological Analysis – Fault Conditions) which provides guidance on Targets 4 – 9 and more general guidance on the radiation protection SAPs is given in T/AST/038. (Radiological Protection).

3. RELATIONSHIP TO SITE LICENCE AND OTHER RELEVANT LEGISLATION

3.1 The Health and Safety at Work, etc., Act 1974 places a duty on the site licensee, in common with all other employers, to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that his employees and persons not in his employment who may be affected are not exposed to risks to their health or safety.

3.2 The Nuclear Installations Act 1965 (as amended) permits ONR to attach to the site licence such conditions as may appear to be necessary or desirable in the interests of safety. Of the 36 conditions currently attached to the licence, certain licence conditions are relevant to assessment of radiological doses during normal operation, in particular:

1) LC 14 (Safety documentation),
2) LC 15 (Periodic review),
3) LC 18 (Radiological protection),
4) LC 19 (Construction or installation of new facility),
5) LC 20 (Modification to design of facility under construction),
6) LC 22 (Modification or experiment on existing facility) and
7) LC23 (Operating rules).

3.3 Similarly, the Ionising Radiations Regulations 2017 [3] (IRR17) and the associated Guidance and Approved Code of Practice [4] (ACoP) are relevant to Targets 1 -3, in particular, Reg. 9 (Restriction of exposure), Reg. 12 (Dose limitation) and Schedule 3 -

Dose limits. In respect of these particular provisions, and IRR17 generally, assessors should note the following:

1) Reg. 9 - **Restriction of exposure** requires every radiation employer to take all necessary steps to restrict so far as is reasonably practicable the extent to which his employees and other persons are exposed to ionising radiation. The means of restricting the exposure include engineering controls, design features, the provision and use of personal protective equipment and warning devices. This restriction of exposure is also fundamental to the SAPs. Guidance on the restriction of exposure is given in the Technical Assessment Guide on Radiological Protection [5] .

2) Reg. 12 - **Dose limitation** requires every employer to ensure that his employees and other persons are not exposed to ionising radiation to an extent that any of the dose limits are exceeded in any calendar year.

3) **Schedule 3** specifies the different dose limits. The BSL(LL) values for employees working with ionising radiation and for persons off the site reflect the dose limits in Schedule 3 for employees and 'other persons' respectively.

4) The facility must be operated, inspected, maintained and decommissioned in compliance with IRR17.

4. RELATIONSHIP TO SAPS, WENRA REFERENCE LEVELS AND IAEA SAFETY STANDARDS

4.1 Fundamental Principle 5 highlights the need for measures to control radiation risks so that no individual bears an unacceptable risk of harm. This Fundamental Principle underpins the radiation protection SAPs RP.1 – RP.7, including the supporting paragraphs, and also Numerical Targets 1 – 3 for normal operation - which are relevant to this guidance.

Relevant SAPs

4.2 The SAPs relevant to this guidance include paragraphs 712 to 720, in particular those SAPs which contain numerical BSL and BSO levels, namely Targets 1, 2 and 3:

Normal operation – any person on the site	**Target 1**
The targets and a legal limit for effective dose in a calendar year for any person on the site from sources of ionising radiation are: Employees working with ionising radiation: BSL(LL): 20 mSv BSO: 1 mSv Other employees on the site: BSL: 2 mSv BSO: 0.1 mSv Note that there are other legal limits on doses for specific groups of people, tissues and parts of the body (IRR17). Normal operational doses should also be reduced ALARP.	

Normal operation – any group on the site	**Target 2**
The targets for average effective dose in a calendar year to defined groups of employees working with ionising radiation are: BSL: 10 mSv BSO: 0.5 mSv	

Normal operation – any person off the site	**Target 3**
The target and a legal limit for effective dose in a calendar year for any person off the site from sources of ionising radiation originating on the site are: BSL(LL): 1 mSv BSO: 0.02 mSv Note that there are other legal limits to tissues and parts of the body (IRR17).	

WENRA Reference Levels

4.3 This guidance is consistent with the current WENRA reference levels [6]. In particular, Issue E: Design Basis Envelope for Existing Reactors states that:

> ”The design basis shall have as an objective the prevention or, if this fails, the mitigation of consequences resulting from anticipated operational occurrences and design basis accidents. Design provisions shall be made to ensure that potential radiation doses to the public and the site personnel do not exceed prescribed limits and are as low as reasonably achievable.”

In this TAG, the prescribed limits for the potential radiation doses to employees on the site and to persons off the site during normal operation are expressed in terms of Basic Safety Levels, some of which are legal limits. ONR’s policy is that the predicted doses for a new facility or activity should at least meet the BSLs and be ALARP.

IAEA Safety Standards

4.4 Targets 1 – 3 and the guidance in this TAG are relevant to and consistent with IAEA safety standards [7,8] and supporting documents. Notably, the fundamental safety objective in IAEA’s fundamental safety principles:

“The fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation.”

This is supported by ten fundamental safety principles of which principles 5, 6 and 7 are particularly relevant to Targets 1 - 3, namely:

"Principle 5: Optimization of protection. Protection must be optimized to provide the highest level of safety that can reasonably be achieved.",

"Principle 6: Limitation of risks to individuals. Measures for controlling radiation risks must ensure that no individual bears an unacceptable risk of harm." and,

"Principle 7: Protection of present and future generations. People and the environment, present and future, must be protected against radiation risks."

5. ADVICE TO ASSESSORS

General

5.1 Assessors should use judgement and discretion to ensure that the assessment is proportionate and targeted. The depth and scope to which this guidance is employed should be determined on a case by case basis.

5.2 The targets are concerned with the predicted radiation doses to employees and to others during the normal operation of facilities on the licensed site. The assessment of the predicted doses aims to establish whether the doses are likely to be within the basic safety levels and objectives, and the extent to which the exposures are restricted and shown to be ALARP.

5.3 Normal operation should include all the activities performed to achieve the purpose for which the facility was constructed, including operation, maintenance, inspection and decommissioning.

5.4 The dose predictions to demonstrate that the radiation doses likely to be received by the employees on the site and persons off the site will meet the targets should be based on

- a knowledge of the radioactive sources and their distribution within the facility of interest;
- the facility design and the proposed system of operation;
- the specific tasks expected to be undertaken by the operators.

The assessor should expect the licensee to adopt a graded approach in which the significant factors, namely those that contribute most to the largest doses, are given greatest consideration.

5.5 All significant sources of radiation should be identified and considered in the dose predictions, including sources brought on to the site for the purposes of work with ionising radiation, or that result from such work e.g. radiography. In addition to the sources in the facility of interest, sources in other facilities on site may also need to be considered, particularly in the case of Target 3. Natural background radiation sources need not be included in the dose estimates, except where work is carried on in an atmosphere containing radon 222 gas at an annual average activity concentration in air exceeding 300 $Bq.m^{-3}$.

5.6 The assessor should ensure that all significant dose pathways have been considered and that the predicted doses take account of contributions from both external and internal exposures. The prediction of doses should take account of the facility design, layout of structures and equipment, characteristics of safety equipment such as ventilation systems and also the different states in which the facility is expected to operate.

5.7 The specific tasks which should be considered are those expected to be carried out by the operators, including contractors, who should be regarded as employees working with ionising radiation. In normal operation these should include all the activities performed to achieve the purpose for which the facility was constructed, including maintenance, inspection and other associated activities e.g. reactor start-up, power operation, shutdown, maintenance, testing and refuelling in the case of a nuclear power plant. Minor incidents arising from these activities which might give rise to operational problems or small unplanned doses to operators should also be regarded as part of normal operation.

5.8 Dose estimates should be made of the highest individual annual dose for assessment against Target 1 and the highest annual group average dose in respect of Target 2. Assessors should be aware that operators may be engaged in several tasks in the facility during the year, in which case it would be appropriate to assume a pro-rata annual dose for comparison with the numerical targets. However, this approach may be unduly restrictive if the tasks are being undertaken over a relatively short period of time, in which case an alternative approach may be justified. For infrequent tasks .e.g. a maintenance task carried out every few years, the assessor should use the predicted dose for the task when comparing with the targets, rather than the dose averaged over a number of years. In the case of Target 3 the dose to a person off the site should be a conservative estimate of the highest dose to a representative person [9].

5.9 The dose to each of the operators will normally be determined from the predicted dose rates where the operators are likely to be positioned for the tasks and the expected periods of time likely to be spent doing the tasks. Account may be taken of the radiation shielding provided by the walls, ceilings and other features e.g. machinery, within the facility. Assessors should ensure that all significant tasks have been included and that the estimates of the dose rates, exposure times and radiation attenuation are sufficiently conservative. However, for the purposes of ALARP considerations the dose estimates should be based on best estimate values for these parameters. Any radioactive contamination that has built-up in the facility and radioactive waste that is stored in the facility should also be included as additional sources of radiation and taken as the maximum values expected during the life of the facility.

5.10 The assessor should consider the adequacy of the methods, data and assumptions used to estimate the doses from direct radiation (shine) to persons off the site and to determine the groups of people likely to receive the highest exposure. The calculations should give conservative estimates of the direct shine dose (neutron and gamma ray) to a representative person within the most exposed group.

5.11 The assessor should be aware that operational experience, including actual doses received by individuals carrying out similar tasks to those expected may sensibly be used to predict the individual and group doses. However, the assessors should be satisfied that the tasks and radiological conditions are sufficiently similar in order to support the licensee’s claims.

5.12 For the dose predictions, uncertainties will arise e.g. in defining the radioactive source term (composition and activity) and in the effectiveness of the shielding, particularly if the shielding design is geometrically complex. The assessor should look to sensitivity studies to establish the degree of conservatism in the predicted doses, particularly if the doses are significantly higher than the BSO.

5.13 If the dose predictions are believed to be conservative, the assessor needs to consider the extent to which the exposures are restricted so far as is reasonably practicable. The assessor should use the following guidance as an aid to decision making:

- Where the predicted dose exceeds a BSL which is a legal limit and further reductions cannot be made, then the assessor should recommend that the proposed facility or proposed modification to an existing facility not be considered for licensing or permissioning.
- Where the predicted dose exceeds a BSL but lies within any legal limit, the assessor should press the licensee for improvements until the cost of further reductions in the radiation risk in terms of time, trouble and money is grossly disproportionate compared to the level of risk reduction.
- The licensee should always be able to demonstrate that the dose is ALARP. The robustness of the demonstration should be on a scale to reflect the range of the predicted doses. If a predicted dose is just below the BSL a thorough and robust ALARP justification will be needed, whereas a simpler justification should be sufficient if the predicted dose is just above the BSO.
- If the predicted dose is less than any BSO, which is regarded as a benchmark that reflects modern nuclear safety standards and expectations, then provided the assessor is satisfied with the validity of the predicted dose, effort need not be spent seeking further safety improvements from the licensee. However, if it is reasonably practicable for the licensee to provide a better standard of safety than that of the BSO, the licensee is obliged to do so.

5.14 ALARP is an essential feature of the SAPs which have BSL and BSO values. Guidance on the general application of ALARP is given elsewhere [10,11,12,13,14]. For the assessment of an existing facility, judgements on what improvements are reasonably practicable may differ from those made for facilities currently being designed and built. This difference needs to be borne in mind by the assessor when considering SAPs Targets 1 – 3. Examples of elements of an ALARP demonstration are given in Appendix 1.

Persons on the site (Target 1)

5.15 Target 1 refers to the BSL and BSOs for various categories of workers on site. Employees who work with ionising radiation are employees who are likely to require regular and frequent access to areas where they are exposed to ionising radiation or where special precautions are required to restrict their exposure. 'Work with ionising radiation' has the same interpretation as in IRR17. The BSL of 20mSv in any year for this category reflects the annual effective dose limit for 'employees' as laid down in IRR17 Schedule 3, Part 1; it should be noted that doses averaged over a period of five consecutive years should not be invoked at the design stage. The assessor should also note paragraph 89 of the ACoP [4] for IRR17 which states that, if a choice has to be made between restricting doses to individuals and restricting doses to a group of persons, priority should be given to keeping individual doses as far below dose limits as is reasonably practicable.

5.16 'Other employees on the site', includes employees who are working on site but are not working with ionising radiation e.g. employees in the general area of offices, canteen and library. In most cases the maximum predicted dose to an employee in the facility of interest will be the most limiting. The predicted dose should be less than the BSL of 2 mSv. Indeed, the ACoP for IRR17 states that the dose control measures should make it unlikely that employees who would not normally be exposed to ionising radiation in the course of their work would receive an effective dose greater than 1 mSv per year.

5.17 Employees on the site who are not working with ionising radiations can be assigned radiation exposures that are simple bounding estimates. The assessor may consider that the associated dose rates and the predicted doses are sufficiently low that it would not be worthwhile to carry out detailed dose calculations. In particular, the radiation from the facility should have a minimal effect on persons in general areas e.g. offices, canteen and library. In such cases it should be sufficient to consider the predicted radiation levels in these areas and to assume that individuals will be present in these areas throughout each day. Access routes to these areas should also be designed to be in low dose rate areas.

5.18 Target 1 also draws attention to other legal limits on doses to tissues and parts of the body. Notably, IRR17 specifies limits for the lens of the eye, skin, hands, forearms, feet and ankles. The general shielding provided to reduce the dose to individuals to acceptably low levels is usually sufficient to prevent most parts of the body from receiving doses in excess of the statutory limits. The assessor should be aware of those operations where there is the potential for high doses to specific parts of the body such as glove-box operations that may give rise to relatively high doses to the hands. The assessor should be satisfied that the predicted doses are ALARP.

5.19 The assessor should ensure that the licensee has arrangements in place for other persons on the site who are not employees e.g. trainees under 18 years of age and members of the public visiting the site. The assessor should be satisfied that the arrangements restrict the exposures of the individuals to ensure compliance with IRR17.

Groups on the site (Target 2)

5.20 Target 2 states the BSL and BSO values for the predicted average radiation dose to a group of workers. The BSL level of 10 mSv in any year is not associated with specific statutory dose limits but is a level that should be readily achievable and ensure that no single group of workers is likely to receive unduly high doses. The licensee should differentiate between employees and non-employees as well as classified and non-classified workers and within each category should identify groups of workers. Typical groups may be based on the type of work carried out such as maintenance, health physics, engineering support and operations. Alternatively the groups may be identified on a facilities basis such as radioactive waste stores, fuel storage ponds. There may also be situations where a combination of these schemes may be more convenient.

5.21 It is important that each group should not be ‘diluted’ with workers who receive very low doses that significantly reduce the average dose to the group. Although the high dose tasks should have been analysed and the need for engineered provisions included in the design, there may be tasks that could give rise to relatively high doses to specific workers. The assessor should be satisfied that there is a satisfactory ALARP assessment for these relatively high dose tasks.

5.22 LC18 is particularly relevant to this SAP in so far as the licensee is required to have adequate arrangements for assessing the average dose to specific classes of persons and to notify ONR if such a dose exceeds the specified level. The need for such a condition arose from the Sizewell ‘B’ Public Inquiry when it was recommended that ONR carry out an investigation if the average annual dose to the Sizewell ‘B’ workforce exceeded 5 mSv.

Persons off the site (Target 3)

5.23 Target 3 refers to the total predicted dose to any person off the site from sources of radiation originating on the site. Again, attention is drawn to other legal dose limits to

tissues and parts of the body, although these are very unlikely to be limiting. The safety case should consider the off-site impact to individuals, either actual or notional. The assessor should note that for the purposes of comparing the predicted doses with the BSL(LL), the sources of radiation should include sources on the site and also sources of radiation that are to be or have been discharged off the site from the operation of the facilities and which could have a radiological impact on persons off the site.

5.24 The Environment Agency (EA) in England, National Resource Wales (NRW) in Wales, and the Scottish Environment Protection Agency (SEPA) in Scotland regulate the discharge and disposal by means of permits or authorisations granted under the relevant environmental legislation: The Environmental Permitting (England and Wales) Regulations 2016 or the Environmental Authorisations (Scotland) Regulations 2018. The authorised discharge limits set by EA, NRW and SEPA should ensure that the doses to a representative person off the site does not exceed relevant dose constraints. The representative person is intended to be representative of persons off the site who are likely to receive the highest dose from sources of radiation off the site. This predicted dose takes account of the different environmental pathways that can contribute to the overall dose to a person off the site, including direct shine from sources on the site which is regulated by ONR.

5.25 For a relatively remote site, the predicted dose to a person may be for a notional person having a relatively low occupancy near the site e.g. from recreational activities. If there is a habitation in the vicinity of the site then the dose to the most exposed occupant should also be estimated on the assumption of a conservative daily occupancy and work pattern e.g. 8 hours outside the house and 16 hours in the house or data from habit surveys if available. The more limiting of the two cases should be considered.

5.26 Where there are a significant number of persons in habitations, recreational areas or other workplaces adjacent to or near the site, the licensee should consider the most limiting dose of such persons. In these cases, the licensee may adopt a representative person approach to estimating doses. The ICRP definition of a representative person is given in ICRP Publication 101[9]. The assessor should be satisfied that whatever approach is used, the predicted dose is calculated in a conservative way and based on a scenario that is plausible. Also, the assessor should note paragraph 717 of the SAPs which refers to a dose constraint of 0.3 mSv pa for each site where there are multiple sites in close proximity.

5.27 The assessor should bear in mind that it is the total predicted dose that should be compared to the BSL/BSO levels and that the direct shine is only one of the contributions to the dose. The summation of the different dose contributions to the representative person for each pathway, may result in an overestimate of the dose likely to be received unless the persons in the different reference groups coincide which is generally not the case. The doses from discharges are presented in the safety case. The assessor should note it is the combined dose from all pathways that should be compared with the dose limit and be demonstrated to be ALARP. In order to be satisfied that the predicted doses are ALARP the assessor may need to discuss the assessed doses from discharges with EA, NRW and SEPA. In particular, if the dose from direct shine is greater than the BSO level, the assessor needs to be mindful of the implications of seeking further reductions in the direct shine doses where this could result in increased levels of discharge. In such circumstances, this should be discussed with EA, NRW or SEPA. The total retrospective doses for comparison against the dose limit for nuclear sites are calculated and published annually in RIFE reports [15] . ONR supplies information on doses from direct shine to the environment agencies to be included in these calculations.

6. REFERENCES

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2. Health and Safety Executive, Numerical Targets and legal limits in Safety Assessment Principles for Nuclear facilities, An explanatory note, December 2006.

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4. Work with Ionising Radiation - Approved Code of Practice for the Ionising Radiations Regulations 2017, HSE Books, 2018.

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6. Western European Nuclear Regulators' Association. WENRA Safety Reference Levels for Existing Reactors. September 2014.

7. IAEA Safety Fundamentals – Fundamental Safety Principles, SF-1, 2006

8. IAEA Safety Standards Series – Functions and Processes of the Regulatory Body for Safety, GSG-13, 2018.

9. Assessing dose of the representative person for the purpose of radiation protection of the public and the optimisation of radiological protection, ICRP 101, 2007.

10. Technical Assessment Guide (Demonstration of ALARP) – T/AST/005.

11. Reducing Risks Protecting People, HSE Books 2001.

12. Principles and guidelines to assist HSE in its judgements that duty-holders have reduced risk as low as reasonably practicable, HSE web site, 2001.

13. Assessing compliance with the law in individual cases and the use of good practice, HSE web site, 2003.

14. Policy and guidance on reducing risks as low as reasonably practicable in design, HSE web site, 2003.

15. Radioactivity in Food and the Environment Reports, published by SEPA.

7. APPENDIX 1 - ALARP – NORMAL OPERATION

1. A demonstration that the doses to employees and others will be ALARP is an essential feature of Targets 1 - 3. Deciding when the level of risk is ALARP needs to be made on a case-by-case basis. A proportionate approach should be used so that the higher the risk, the greater the degree of disproportion is needed before the licensee can be deemed to have discharged his duty.

2. Guidance on ALARP [10,11,12,13,14] highlights the importance of applying relevant good practice as part of an ALARP justification. Good practice is the generic term for those standards for controlling risk which have been judged and recognised by HSE or ONR as satisfying the law when applied to a particular relevant case in an appropriate manner. The main sources of written, recognised good practice include Approved Codes of Practice (ACoPs), in particular the ACoP for IRR17, HSE Guidance, British Standards and guidance produced by the Society for Radiological Protection or a relevant recognised body, as well as good practices used at other facilities and sites. There may also be codes of practice and unwritten sources of well-defined and established standard practice adopted by the radiation protection community.

3. The assessor should consider the extent to which the licensee provides evidence that good practices will be applied. Examples of good practice include:

a. **Commitment to ALARP practices**. The corporate procedures should highlight the responsibilities at various levels in the organisation and identify the

relevant radiation protection objectives, standards and procedures consistent with IRR17 and current good practice. There should be a commitment to ALARP at all levels in a licensee's organisation.

b. **Dose reduction working groups**. Groups should be set up to identify improvements in plant and its operation in order to restrict occupational doses, including doses to the public, to ALARP levels. The groups should involve relevant stakeholders from the plant operations, management, safety representatives, etc. and would usually be specific to a facility or operational area. The effectiveness of the measures that are implemented should be reviewed by the groups.

c. **Staff training**. Radiation protection training should be provided at all management and operational levels in the organisation. The training should cover basic radiation protection, in particular the importance of minimising occupational exposures and of establishing an ALARP culture throughout the workforce. Refresher training should also be provided. Level of knowledge of senior management about the occupational exposure strategy and how it is achieved is a useful indicator.

d. **Risk assessment**. Risk assessments will need to be in place for all work activities involving ionising radiation in order to comply with Reg. 8 of IRR17. The risk assessment should address the range of potential faults that could occur and the likely consequences and the measures to minimise the likelihood of such events and the associated consequences.

e. **Work planning and scheduling**. Important elements of a work planning and scheduling programme include the use of decision aiding techniques, ALARP checklists to identify those factors that need to be considered before work is carried out, checklists for pre-job and post-job briefings and task feedback.

f. **Identification of control measures**. The likely and potential exposures, identified in the risk assessment, should be restricted by means of a hierarchy of controls - preferably by means of engineering controls and design features, then supporting systems of work and lastly personal protective equipment.

g. **Identification of management controls**. There should be standards and procedures to demonstrate compliance with IRR17 and with current good practice. The management controls should also include provisions for assessment and review.

h. **Dose budgets**. Realistic estimates should be made of the likely occupational exposures prior to the commencement of work. Dose sharing as a primary means of managing exposures should be avoided.

i. **Task specific training**. In addition to the general training on occupational exposures and ALARP there should be effective planning and training on specific tasks to be carried out e.g. the use of mock-ups in order to familiarise workers with potential problems and to improve their skills in carrying out the tasks. In this way, tasks can be carried out more efficiently in a radiation environment thus reducing occupational doses.

j. **Dose target/objectives**. Challenging dose targets/objectives should be set for specific tasks, series of tasks and for specific time periods e.g. shift. In the context of new nuclear reactor build, Ref. 10 includes the requirement that the level of safety for new facilities must be no less than a comparable facility already working or being constructed in the UK or somewhere else in the world. For normal operational doses this principle may be applied as a challenge to a range of targets/objectives including maximum doses to workers and members

of the public and in the case of nuclear power plants, collective worker dose for outages and per GWh generated.

k. **Effectiveness of ALARP measures**. There should be reviews of the effectiveness of the ALARP measures e.g. expected doses and actual doses may be compared during major projects whilst work is in progress.

l. **Incidents and near misses**. The record of incidents including near misses which have radiological consequences or the potential for such consequences is a measure of how well occupational exposures have been managed. The types of incidents/near misses are also relevant e.g. contamination incidents where the actual doses may be very small but the potential doses may be large. The nature and thoroughness of the licensee's investigations should be commensurate with the actual or the potential radiological consequences. The actions to prevent incidents recurring should be taken without undue delay and should be effective. Root cause analyses of the information should also be carried out by the licensee.

4. Recent dose data from licensees, when available, may also be useful in assessing how well a licensee will manage occupational exposures and also in highlighting potential problem areas. The assessor should note the following aspects:

a. High doses do not necessarily imply poor management of occupational exposures. For example, doses from decommissioning work which is done now, may give rise to relatively high doses which may be ALARP. Such work could significantly reduce future doses and risks to workers/public and also be in line with currently agreed policy.

b. Low doses do not necessarily imply good management of occupational exposures. For example, there may be situations where workers receive only a few mSv per year but should be receiving essentially no dose.

c. Dose trends should be interpreted with caution. Although there are sites where similar operations are carried out year after year, and where one could reasonably expect decreasing dose trends, there are other sites e.g. dockyards, where the nature of the operations can change significantly from one year to the next and an increasing dose trend may be due to an increase in the work with ionising radiation.