Office for Nuclear Regulation

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RADIOLOGICAL PROTECTION			
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1. INTRODUCTION

1.1 The Office for Nuclear Regulation (ONR) has established its Safety Assessment Principles (SAPs) [1] for Nuclear Facilities which apply to the assessment by ONR specialist inspectors of safety cases for nuclear facilities that may be operated by potential licensees, existing licensees, Ministry of Defence (MoD) authorised sites 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 (TAG) is one of these guides.

2. PURPOSE AND SCOPE

2.1 This TAG contains guidance to advise and inform ONR inspectors in the exercise of their regulatory judgement in respect of the assessment of radiation protection, as described in outline in ONR SAPs [1]. A demonstration of the means of achieving effective radiological protection and control is an essential part of the licensee's nuclear safety submissions to ONR. The provision of adequate protection for persons against ionising radiations is required during normal operations and also under fault and accident conditions. Fundamental Principle FP.8 of ONR's SAPs states the general requirement for people, present and future, to be protected against radiation risks. This is supported by FP.5 (see NS-TAST-GD-004) [2] that provides for the limitation of risks and specifically requires that no individual should bear an unacceptable risk of harm. FP.3 requires protection to be optimised to give the highest level of safety that is reasonably practicable. In addition to principles aimed at ensuring that the radiation safety objectives in these Fundamental Principles have been met (through engineering, management and operational provisions), the SAPs include a specific section on the principles of radiation protection (RP1 – RP7). Paragraphs 576-604 of the SAPs contain specific guidance on measures to achieve the objectives of the principles. This TAG does not reproduce those paragraphs, rather it summarises them and provides supplementary guidance; notably, it does not give guidance on radiological analysis and the interpretation of numerical dose targets or emergency response arrangements.

2.2 It should be noted that licensees of nuclear installations are required to comply with the Ionising Radiations Regulations 2017 (IRR17), which has an associated Approved Code of Practice and guidance [3][4] which lay down the statutory requirements for the protection of persons against ionising radiation arising from work activities.

2.3 Other key guidance which is relevant to this TAG is given in NS-TAST-GD-043 (Radiological Analysis – Normal Operation) [5] which provides guidance on Targets 1 – 3 and also guidance given in NS-TAST-GD-045 (Radiological Analysis – Fault Conditions) [6] which provides guidance on Targets 4 – 9. Other relevant TAGs are referred to in the text.

3. SITE LICENCE CONDITIONS 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 (SFAIRP), that his employees and persons not in his employment who may be affected are not exposed to risks to their health or safety.

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 Licence Conditions (LC) attached to the standard site licence, eight are of particular relevance to the SAPs covered in this guide. These are:

1) LC 9 (Instructions to persons on the site),
2) LC 14 (Safety documentation),
3) LC 18 (Radiological protection),

4) LC 23 (Operating Rules),
5) LC 24 (Operating Instructions),
6) LC 26 (Control and supervision of operations),
7) LC 28 (Examination, inspection, maintenance and testing), and
8) LC 29 (Duty to carry out tests, inspections and examinations).

3.2 Ionising Radiations Regulations 2017 and Approved Code of Practice (ACoP)

1) The Ionising Radiations Regulations 2017 [3] and the supporting ACoP and guidance [4] lay down the statutory requirements for the protection of persons against ionising radiation arising from work activities. A facility must be designed, operated and decommissioned in compliance with these legal provisions. Regulations of particular relevance to the radiological protection aspects of the SAPs are highlighted in the following paragraphs.

2) Regulation 8 – **Radiation Risk Assessments** – before work is undertaken every radiation employer must carry out a risk assessment to identify the hazards and evaluate the risks to the workforce and to others. It should be noted that Regulation 3 of the Management of Health and Safety at Work Regulations 1999 (MHSWR99) [7] requires the risk assessment to be reviewed and kept up to date. A Radiation Risk Assessment (RRA) should be considered in assessing the adequacy of the radiological protection aspects of the SAPs.

3) Regulation 9 - **Restriction of exposure** – this requires every radiation employer, in relation to any work with ionising radiation that he undertakes, to take all necessary steps to restrict SFAIRP the extent to which his employees and other persons are exposed to ionising radiation. The means of achieving this is the primary objective of the safety submission on radiological protection and all radiological protection aspects of the SAPs are relevant in judging the extent to which exposures are restricted.

4) Regulation 10 - **Personal Protective Equipment** - this requires that any such equipment provided by the employer for the restriction of exposure to be suitable, adequate and properly used. SAPs RP.1, RP.2, RP.3 and RP.4 and associated guidance include the need for protecting persons against ionising radiation.

5) Regulation 11 – **Maintenance and examination of engineering controls etc. and personal protective equipment** – this requires the radiation employer to maintain, examine and test engineering controls and safety features. The claims on the reliability of engineering controls and safety features, e.g. interlocks, should be presented in the safety case and are important in assessing the adequacy of the radiological protection aspects in RP.1, RP.2., RP.3, RP.6 and RP.7.

6) Regulation 12 – **Dose Limitation** – this requires every employer to ensure that dose limits specified in Schedule 3 of the Regulations [3] are not exceeded in any calendar year. The regulation specifies the means of assessing effective dose and equivalent dose from external radiation, and of committed effective dose and committed equivalent dose following intakes of radionuclides into the body, for this purpose. SAPs RP.1 and RP.2 and associated guidance include the need for estimation, monitoring and assessment of radiation doses and identification of emergency exposure dose levels.

Schedule 3 has the effect of specifying relevant dose limits for different classes of person: adult employees aged 18 or over; trainees aged 16 to 18; and any other person. No person under 16 years of age should therefore be occupationally exposed to ionising radiation.

Schedule 3 dose limits include dose limits for the lens of the eye, including 20 mSv in a calendar year for employees over 18 years of age.

7) Regulation 16 – **Co-operation between employers** – where work undertaken by one employer is likely to give rise to the exposure to ionising radiation of the employee of another employer, this regulation requires those employers to co-operate to ensure that both are able to comply with IRR17. An example would be where a contractor might carry out radiography in an enclosure on a nuclear site. In such cases, where employees are engaged in work involving radiation sources that are not under the control of their employer, the allocation of responsibility between the employers should be clear and documented. This aspect should be considered in assessing the adequacy of the radiological protection aspects of the SAPs.

8) Regulation 17 - **Designation of controlled or supervised areas** – this requires an employer to designate an area as a controlled area or supervised area depending on certain considerations such as the need to follow special procedures or likely dose to be received. The requirements for an area to be designated as 'controlled', and those for a person to be designated as 'classified', are based on the likelihood of an employee receiving an effective dose greater than 6 mSv a year or an equivalent dose greater than 15 mSv a year for the lens of the eye or greater or greater than 150 mSv a year for the skin or the extremities. Hence those routinely working in controlled areas are usually designated as 'classified' and so subject to dose assessment and recording (under Regulation 22). The requirement for an area to be designated as 'supervised' is based on the need to keep the conditions of the area under review to determine whether the area should be designated as a controlled area, or on the likelihood of an employee receiving an effective dose in excess of 1 mSv per year or an equivalent dose of one tenths of any dose limit. Hence those routinely working in supervised areas need not be designated as classified workers. Monitoring should normally involve individual dose estimation and recording and health surveillance.

SAP RP.3 expects, where appropriate, areas to be further divided, with associated controls, to restrict exposure and prevent the spread of radioactive contamination.

9) Regulation 20 - **Monitoring of designated areas** – this requires an employer to ensure that the levels of ionising radiation are adequately monitored for each controlled and supervised area and that working conditions in those areas are kept under review. Paragraphs 589 and 592 of the SAPs, relevant to RP.1 and RP.2, highlight the need to have monitors available for making estimates of doses and to detect breakdowns in systems and controls. Such arrangements provide the operator with information to control exposure on an ongoing basis to ensure that exposure to ionising radiation is restricted as required by IRR17 Regulation 9. SAP RP.4 includes the need for monitoring and controlling any spread of airborne activity and contamination within and beyond contaminated areas.

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

Relevant SAPs

4.1 The SAPs covered by this TAG are RP.1 to RP.7 and the supporting paragraphs 576-604.

4.2 RP.7 specifies the need to establish a hierarchy of control measures to optimise protection in accordance with IRR17.

4.3 RP.1 specifies the need to provide adequate protection against radiation and radioactive substances in those areas of a facility to which access needs to be gained during normal operations.

4.4 RP.2 specifies a similar need as RP.1 for accident conditions. Adherence to these principles is fundamental to restricting radiation exposure

4.5 RP.3 specifies the need for designated areas and controls to restrict exposures and prevent the spread of radioactive material. The control measures should be commensurate with the radiation risk in the area.

4.6 RP.4 specifies the need for measures for the protection of people entering and working in contaminated areas.

4.7 RP.5 specifies the need for provisions for the decontamination of people, articles and areas. Paragraph 600 expressly covers monitoring of articles to be removed from, or any person leaving, contaminated locations and local and central decontamination facilities. Decommissioning also involves decontamination; see SAPs DC.1 to DC.9 and NS-TAST-GD-026 [8] for specific requirements and guidance on design for decommissioning and safety during decommissioning.

4.8 RP.6 specifies the need for shielding to be effective under normal operation and fault conditions where it provides this safety function. See NS-TAST-GD-002 [9] for further guidance.

WENRA Reference Levels

4.9 The objective of the Western European Nuclear Regulators Association (WENRA) harmonisation programme is to develop a common approach to nuclear safety in Europe by comparing national approaches to the application of International Atomic Energy Agency (IAEA) safety standards. This guidance is consistent with the current WENRA reference levels [10]. 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, guidance is given on the design provisions to ensure that radiation doses to persons on and off the site are restricted within the limits prescribed in IRR17 and to be As Low As Reasonably Practicable (ALARP).

National and International Guidance

4.10 There is a range of national and international guidance on radiation protection. Notably, ONR assessment should take account of the guidance issued by the IAEA (i.e. Safety Standards and Guides, [11, 12, 13, 14, 15 & 25]), the International Commission on Radiation Protection (ICRP) and the UK's Centre for Radiation, Chemical and Environmental Hazards of Public Health England (PHE) (National Institute for Health Protection (NIHP) from April 2021).

4.11 IAEA safety standards [11, 12, 13, 14 & 25] and supporting documents are relevant to the numerical targets 1 – 9, IRR17 and are consistent with the guidance in this TAG. The fundamental safety objective in IAEA's Fundamental Safety Principles [16] is "to protect people and the environment from harmful effects of ionising radiation." The supporting paragraph in the Fundamental Safety Principles states that:

> "To ensure facilities are operated and activities conducted so as to achieve the highest standards of safety that can reasonably be achieved, measures have to be taken:

(a) To control the radiation exposure of people and the release of radioactive material to the environment;
(b) To restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation;
(c) To mitigate the consequences of such events if they were to occur."

IAEA safety requirements for nuclear power plants [15] (Requirement 20: Radiation protection) expect a radiation protection programme to have sufficient independence and resources to be able to enforce and to advise on legislation, standards, procedures and safe working practices. In addition, the programme should ensure control of radiation exposure during activities such as fuel handling, and from radioactive substances in fuel coolant (liquid or gas) and associated fluids arising from plant chemistry.

IAEA's governmental, legal and regulatory framework for safety [25] (Requirements 25 and 26) set out the standards expected of the safety regulator during the review and assessment of information relevant to safety.

5. ADVICE TO INSPECTORS

Advice on radiological protection aspects of the SAPs

5.1 The purpose of this guidance is to ensure that those in ONR who are assessing radiation protection elements of a safety case, and who have a good working knowledge of the subject, are better placed to examine safety cases and to identify in the context of our regulatory function any possible weakness or safety issues of concern.

5.2 A primary element of the safety case for a facility should be a strategy for restricting radiation exposure to show how restriction has been achieved. The strategy should cover all sources of radiation arising from the plant and should incorporate all reasonably practicable measures for reducing exposures. SAPs paragraph 585 states that minimisation of sources is a key consideration in design in terms of both volume and activity throughout the lifetime of the facility, and in relation to both generation of radioactive material and build-up of such material. For example, consideration should be given to choice of materials to minimise the formation of activated corrosion products and incorporation of techniques such as flushing, washing and decontamination to remove radioactivity from circuit components and also to the minimisation of surfaces where radioactive material can accumulate. Remotely operated devices should also be carefully considered to reduce the need for persons to work in high dose rate areas or to handle radioactive material directly. Paragraph 585 also outlines the considerations for the optimisation of protection, noting that collective dose as well as individual doses should be ALARP. Optimisation should relate to all significant tasks or operations. The balance between occupational exposure and public exposure should be considered, taking account of normal operation radiation risks and accident radiation risks. Optimisation should be pursued at all stages of design and modification.

5.3 RP.7 concerns the hierarchy of control measures and paragraph 584 of the SAPs also highlights IRR17 Guidance regarding a hierarchy of control measures for restricting exposure of people to radiation. It is essential for radiation sources to be controlled so far as reasonably practicable before placing controls on individuals. Thus, priority should be given to engineered means, including passive design features and engineered safety systems, before resorting to systems of work, other administrative measures or Personal Protective Equipment (PPE). Engineered features generally provide for high reliability whereas administrative controls, such as restrictions on access and occupancy, are susceptible to defeat and inappropriate behaviour. The provision and use of PPE is the last consideration in the hierarchy; it should be provided to further restrict exposure

where reasonably practicable. Safety should be ensured for people to enter any part of a facility to which access needs to be gained during normal operation or for the purpose of accident prevention or mitigation. Inspectors should seek evidence from the safety case that a design and operation philosophy based on these points has been developed and applied.

5.4 For RP.1 and RP.2, there is a need for a thorough assessment of the radiation hazards and risks, including the magnitude and location of all actual and potential radiation sources. The safety case should provide evidence of a systematic process of radiation hazard and risk identification. For RP.1, the safety case should demonstrate how the protection is adequate for the radiation hazards and risks during normal operation. For RP.2, the protection should be shown to be adequate for radiation hazards and risks that might arise during accident conditions (also see NS-TAST-GD-041 on criticality safety [17]).

5.5 SAPs paragraph 588, relating to RP.1 and RP.2, refers to the requirement for the measurement of radiation doses to individuals. The safety case should include the following points:

1) Classified persons in designated areas (see 5.7 below) should be provided with and should wear dosemeters issued by an Approved Dosimetry Service (ADS) in the facility. There should also be provision for the monitoring of internal doses where assessment indicates the possibility of inhalation, ingestion, injection or absorption of radioactive material.

2) Where a direct reading of the dose incurred can reasonably be used to help restrict exposure, people should be issued with and should wear, for example, Electronic Personal Dosemeters (EPDs).

3) The estimation of individual dose through the use of installed monitoring instruments and by the use of hand held instruments together with estimates or predictions of the occupancy-times of individuals.

4) In areas where there is the potential for significant intakes of airborne radioactive material, people working in the area should normally wear Personal Air Samplers (PASs).

5) The system of work should specify the areas that can be entered and for what purpose. It should specify the level to which the radiation dose will be controlled. The measures for ensuring that exposure is reduced SFAIRP should also be specified. The system of work and monitoring devices should be designed to enable corrective actions to be taken if appropriate.

5.6 Paragraphs 592-594 of the SAPs give further guidance on instrumentation and alarms for airborne and direct radiation monitoring, including the need for remote indication for accident situations. The need for criticality incident detection is also addressed. Inspectors should refer to these paragraphs for guidance on points to be covered in safety cases (also see NS-TAST-GD-018 on criticality warning systems [18]).

5.7 RP.3 indicates the need for controls in various areas of the facility commensurate with the radiation hazards in those areas. The area design requirements and access controls should always aim to keep exposures ALARP. The zone category should be an indication of the required degree of engineered and managerial controls and should increase (e.g. C1, C2, C3 etc. and R1, R2, R3 etc.) for increasing levels of contamination and radiation respectively. The safety case should make clear the zone categorisation, or area classification system, and corresponding protection arrangements.

5.8 Control of entry to the lowest category zone may be sufficient through the installation of physical barriers and warning signs whereas the controls in the highest zone may require segregation through shielding and mechanical interlocks. Access to the facility control room and other low-radiation areas with high occupancy should not require access through zones that would require substantial precautions. Higher category zones should be nested within the less highly categorised zones; for example, a higher contamination zone should be surrounded by or at least accessed by a lower contamination zone and the ventilation arrangements should ensure airflow is from lower to higher category zones (see NS-TAST-GD-022) [19]. The design layout should facilitate the radiation protection controls and restrict radiation exposure as far as is reasonably practicable. For example, components containing little or no radioactivity should, where feasible be located outside areas where the radiation levels are high; components used in high radiation levels should be designed to be easily removable if maintenance is required and provision should be made, where necessary, to sample radioactive liquids in such a way as to minimise exposure and spread of contamination.

5.9 Paragraph 597 of SAPs relates to facility areas where the dose rates are sufficiently high that exposure for a matter of minutes could give rise to a significant dose. A significant dose should be taken as 1/10 of any relevant dose limit. For such areas there must be effective control of entry to prevent unauthorised access. Controls should include effective devices such as mechanical interlocks, alarms and/or locked doors. Permits to work should also be considered. In assessing the arrangements, inspectors need to ensure that the licensee has identified and minimised the risks of defeating the controls. Paragraph 597 also highlights the need to justify the viability of prompt escape from such places in the safety case. If it is not reasonably practicable to provide physical control measures then an equivalent standard of access control should be shown to apply. In any such case where brief entry is envisaged as part of normal operation or remedial action, the safety case should be robust and show that statutory dose limits will be complied with and the exposure will be ALARP.

5.10 RP.4 relates to measures for the protection of people entering and working in contaminated areas. Paragraph 598 of SAPs indicates that this includes monitoring for, and control of, the spread of airborne activity and surface contamination within and beyond each area; and there should be appropriate monitoring and precautions against associated radiation. In addition to provisions for protecting persons against external radiation, the provisions for protecting persons entering and working in a contaminated area should, so far as is reasonably practicable, be engineered provisions, such as:

1) The ventilation of contaminated areas and areas with airborne activity (with due precautions to protect persons from concentrations of contamination in filters).

2) The use of shielding and distance e.g. by use of long tools, for surface contamination.

3) Clearly marked evacuation routes.

4) The use of containment.

5) Provision and use of change rooms and washing facilities to control entry to, and egress from, contamination areas. Further information is given in the Industry Code of Practice [20].

The above list is not exhaustive. Engineered provisions and systems of work are preferred to the use of PPE (see paragraph 5.3 above). Nevertheless, PPE will likely be necessary in those situations where full protection cannot be provided by engineered means. In such cases the appropriate PPE, including Respiratory Protective Equipment

(RPE), must be worn. In selecting PPE the nature of the exposure, the performance of the PPE, and dose constraints should be considered. Optimisation should take account of any associated non-radiological risks and, in locations where ambient radiation dose rates are significant, any potential increases in radiation exposure arising from wearing PPE due to any additional time taken to perform tasks. Examples of PPE include, but are not limited to, disposable coveralls, gloves, overshoes, eye protection, organ shields, shielded aprons and RPE. Examples of RPE include, but are not limited to, respirators (e.g. filtering face-piece, half mask, full face, powered) and breathing equipment such as ventilated pressurised suits. Further information is available on RPE [21, 22] and on air fed suits in nuclear decommissioning [23]. In general, explicit consideration should be given during the design of a facility to the ease of worker access and minimisation of the time required for tasks in areas with substantial radiation and/or surface contamination risks. The safety case should show how these considerations are realised.

5.11 For monitoring and controlling airborne activity levels, surface contamination levels and direct radiation within and beyond each area, the provisions should include:

1) Monitoring

a) Baseline survey e.g. a radon survey of the facility before the introduction and use of radioactive materials, including the site surroundings where appropriate. Consideration of airflow patterns may be necessary in some situations.

b) The use of appropriate, well-maintained and calibrated instruments in each area and at the exit of the area.

c) A schedule of radiation and contamination (surface and airborne) surveys.

d) Records of the monitoring results and checking for trends.

2) Controlling

a) Review of monitoring results to establish if action is needed e.g. removal of contamination from surface.

b) Use of change-rooms and sub change rooms. Further information is given in the Industry Code of Practice [20].

c) Use of shielded enclosures and shielded packages.

d) The use of suitable surface finishes to facilitate decontamination.

e) The avoidance of inaccessible corners or crevices where contamination can accumulate.

f) The use of 'tacky mats' to limit the spread of contamination.

g) The use of hold-down coatings.

The above lists for monitoring and controlling the spread of airborne activity are not exhaustive, and safety cases should show how these and other provisions restrict exposures so far as is reasonably practicable.

5.12 RP.5 relates to decontamination. It should be recognised at the facility design stage that decontamination of people, articles and areas may be required. Local decontamination plant should be included unless a centralised decontamination plant serving more than

one facility is shown to be more appropriate. The design provisions should be suitable to deal with contamination arising in both normal operation and accidents, and during decommissioning. Features as in 5.11 above may also facilitate decontamination.

5.13 SAPs paragraph 601 relates to the manipulation of items having high surface radiation dose rates, including highly contaminated items, used fuel elements, irradiated items and radioactive sources. There should be provision so that operators do not handle any radioactive sources with bare hands. Any safety case proposing to allow sources to be handled by the operator protected by gloves should receive specific assessment attention. The use of manipulators through a shielded wall is a common means of reducing the radiation dose to the operator. Other means of dose reduction include self-propelled remotely operated or robotic devices, and taking advantage of pond water for shielding of operators. For items likely to become highly contaminated, manipulation must be carried out in enclosures that are purpose built to minimise the spread of radioactive contamination. Shielded enclosures and manipulation systems should be designed and operated to facilitate decontamination and decommissioning at end of life.

5.14 RP.6 on shielding emphasises the importance of the effectiveness of shielding under all conditions. SAPs paragraphs 602-604 indicate some of the issues to be considered when assessing the adequacy of shielding. Shielding may be an effective passive safety measure if it is correctly installed and permanently fixed. For complex shielding designs and long required lifetimes careful consideration is required of its engineering. Where liquids are used as the shielding medium, SAPs paragraph 604 highlights the need for special attention to the possibility of leakage or loss of fluid. Consideration should be given to the provision of shielding to protect the public as well as on-site personnel following an accident. Where radioactive material is to be transported or moved on-site, appropriate shielding and packaging should be used. (Transport off-site is subject to separate regulation.) Further guidance is given in NS-TAST-GD-022 [19] and NS-TAST-GD-002 [9].

General radiological protection advice to inspectors

5.15 Radiation protection should be covered in local rules and supervision of work, training, and arrangements for emergency response. Staff health surveillance should include radiological considerations, including provision for monitoring for intakes of radioactivity. Contractors should be covered, either with their own arrangements in liaison with the licensee or within the licensee's arrangements. It is important that the employers concerned cooperate to the extent necessary to ensure that each is enabled to comply with the statutory requirements (see Regulation 16 IRR17). Individual responsibilities in the direct management line and in specialist support functions at all levels, including those of the individual workers, should be clear and understood. For example, individuals should be made aware of their responsibilities for keeping their radiation doses ALARP by following training and procedures.

5.16 In carrying out an assessment, ONR inspectors need to judge the extent to which a safety submission shows that the design of the plant and the proposed operations meets the expectations in the SAPs and the requirements in the IRRs, using the guidance above and in SAPs paragraphs and IRR Guidance.

- For the assessment of existing plant there may be differences from what is reasonably practicable in plants currently being designed and built. This difference needs to be borne in mind by inspectors, for example when considering the practicalities of the restriction of access to areas with significant radiation intensity, or in decommissioning or other once-off activities (see NS-TAST-GD-005 on ALARP [24]).

- There will also be a different emphasis on certain SAPs when assessing safety submissions for different types of plant e.g. reactor plants and chemical plants.

Chemical plants by their nature are likely to have several areas where there are significant sources of radioactivity with the potential for leaks and the resultant spread of radioactive contamination. SAPs RP.4, RP.5 are particularly relevant to such cases.

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