Office for Nuclear Regulation

SIXEP Continuity Plant

Agreement to commence construction and installation of the SIXEP Continuity Plant

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EXECUTIVE SUMMARY

Title
Agreement to commence construction and installation of the Site Ion Exchange Plant Continuity Plant.

Permission Requested
Sellafield Limited (SL) has written to the Office for Nuclear Regulation (ONR) requesting Agreement under its arrangements for Licence Condition (LC) 19, construction or installation of new plant, to commence construction and installation of the Site Ion Exchange Plant (SIXEP) Continuity Plant (SCP). This Project Assessment Report records ONR's assessment of SL's proposal.

Background
The SIXEP sea discharge treatment plant (SDTP) provides abatement for high volume, low to medium activity beta/gamma aqueous effluents. SDTP supports the management of pond water activity levels in the fuel handling plant and first generation Magnox storage ponds by treating pond purges. The plant also supports management of radioactive aqueous wastes arising from the Magnox swalf storage silos. The plant is the prime means of protecting the public and the environment from radioactivity in aqueous liquid effluent discharges from Sellafield site. It is also of critical importance to sustaining the site's hazard and risk reduction programme.

SIXEP commenced operation in 1985 and whilst currently safe and operational, is now beyond its original design life of twenty five years. The functionality for aqueous effluent abatement provided by SDTP will be required to support site missions until at least 2060.

SL has justified the continued safe operation of SIXEP. However, studies undertaken by SL indicated that SIXEP is vulnerable to failure by 2050, with the risk of failure increasing from 2025 onwards. SL and ONR consider that prolonged unavailability of SDTP is unacceptable given its strategic safety functional importance to the Sellafield site.

SL is constructing SCP to provide the continued functionality of SDTP on as short a timescale as practically possible. SCP is of strategic importance to the site mission, particularly given that it supports site-wide risk and hazard reduction activities. Environmental review and technology studies undertaken by SL indicated that using existing SDTP technology is the best available technique to meet the project timescales of having the plant available as soon as possible.

SL is planning to commence construction of the SCP concrete base slab in June 2020. The SCP programme date for active operation is currently between 2028 and 2032, depending on assumed confidence levels. ONR will decide subsequent regulatory permissioning hold-points as the project progresses. SL has categorised SCP as safety category B, significant nuclear safety proposal.

SL has assessed externally and internally initiated hazards for SCP. The higher consequence unmitigated faults related to these could potentially result in radiological doses to the public and workers of 0.75 millisieverts (mSv), and between 20 and 1000 mSv, respectively. To mitigate against any risks to workers or public safety, the SCP design includes engineering and administrative safety measures to control faults within the design basis and to provide the necessary defence in depth.

Assessment and inspection work carried out by ONR in consideration of this request
ONR has undertaken regular engagements with SL since the SCP project was first initiated in 2015. In 2019, following my initial consideration of SL's proposal, I judged it proportionate to obtain specialist inspector advice from the following ONR specialisms: mechanical

engineering, structural integrity, civil engineering, human factors, fault studies, nuclear liabilities, internal hazards, chemical engineering, and electrical control and instrumentation engineering.

Matters arising from ONR's work

ONR's assessment of SL's proposal to commence construction and installation of SCP identified a number of shortfalls against ONR guidance and relevant good practice. In each case the inspector judges that the nature and magnitude of the shortfalls is such that implementation of options to address them would not be foreclosed by the commencement of construction and installation.

The shortfalls and associated recommendations are incorporated as actions in the level 3 Regulatory Issue 7940 associated with this permissioning activity. ONR will use the Regulatory Issue to manage SL's implementation of the actions in accordance with ONR regulatory guidance.

All of the inspectors involved in this assessment support ONR agreeing to SL commencing construction and installation of SCP.

Conclusions

Overall, based on the findings of my review of SL's safety case submission and the ONR specialist inspectors' assessments, I consider that SL has:

- Provided adequate evidence that the risks to workers and the public arising from the construction and installation of the SCP have been identified and will be controlled to as low as reasonably practicable.
- Provided adequate evidence that the proposal has been subject to an adequate level of internal and independent oversight, governance and challenge in accordance with SL's established Licence Condition compliance arrangements.

Where shortfalls have been identified in the regulatory assessment, these are not judged as safety significant. ONR is content that the nature and magnitude of these are such that commencing construction and installation will not foreclose implementation of options to address them.

Recommendation

I recommend that ONR issues Licence Instrument 528 Agreement to Sellafield Limited commencing construction of SCP.

LIST OF ABBREVIATIONS

ALARP	As low as reasonably practicable
BAT	Best Available Techniques
BIM	Building Information Modelling
BSM	Basket Safety Measure
BST	Bulk Storage Tank
CHS	Conventional Health and Safety
C&SE	Civil and Structural Engineering
DBA	Design Basis Analysis
DBAA	Design Basis accident Analysis
EA	Environment Agency
EC&I	Electrical Control and Instrumentation
HOW2	(Office for Nuclear Regulation) Business Management System
HPCP	Hold Point Control Plan
IX	Ion Exchange
LC	Licence Condition
MSSS	Magnox Swalf Storage Silos
NIO	Nuclear Independent and Oversight
ONR	Office for Nuclear Regulation
PAR	Project Assessment Report
PSA	Probabilistic Safety Analysis
PSR	Preliminary Safety Report
RGP	Relevant Good Practice
SAA	Severe Accident Analysis
SAP	Safety Assessment Principle(s)
SCP	SIXEP Continuity Plant
SDTP	Sea Discharge Treatment Plant
SFAIRP	So far as is reasonably practicable
SIXEP	Site Ion Exchange Plant
SL	Sellafield Limited
SM	Safety Mechanism
SRE	Safety Related Equipment
SSC	Structure, System and Component
TAG	Technical Assessment Guide (ONR)
UV	Universal Vessel

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1 PERMISSION REQUESTED

1. Sellafield Limited (SL), the licensee of the Sellafield Site, has written (ref.1) to the Office for Nuclear Regulation (ONR) requesting Agreement under its arrangements for Licence Condition (LC) 19, construction or installation of new plant, to commence construction and installation of the SIXEP continuity plant (SCP).

2. SL has submitted the SCP safety case summary report (ref.2) and supporting safety case evidence that it considers provides sufficient confidence to commence plant construction and installation. This project assessment report (PAR) presents ONR's assessment of SL's proposal.

2 BACKGROUND

3. The Sellafield Site Ion Exchange Effluent Plant (SIXEP) sea discharge treatment plant (SDTP) provides abatement for high volume, low to medium activity beta/gamma aqueous effluents, specifically effluent arising from the Magnox Swalf Storage Silos (MSSS). MSSS has been classified as an intolerable facility and removing the associated high hazard and risk is a national priority. SDTP also supports the management of pond water activity levels in the fuel handling plant and first generation Magnox storage ponds by treating pond purges.

4. The SDTP is the prime means of protecting the public and the environment from radioactivity in aqueous liquid effluent discharges from Sellafield site. The plant is also of critical importance to sustaining the site's hazard and risk reduction programme. SIXEP commenced operation in 1985 and is now beyond its original design life of twenty five years. The safety functionality for aqueous effluent abatement provided by SDTP will be required to support site missions until at least 2060.

5. Studies undertaken by SL indicated that SIXEP is likely to fail by 2050, with the risk of failure increasing from 2025 onwards. The studies highlighted critical plant items, such as those associated with SDTP, present the long-term risk of failure to the abatement capacity. SL and ONR consider that prolonged unavailability of SDTP is unacceptable.

6. SL is constructing SCP to provide the continued functionality of SDTP on as short a timescale as practically possible. SCP is of strategic importance to the site mission in that it supports site-wide risk and hazard reduction activities.

7. Environmental review and technology studies undertaken by SL indicated that using existing, proven SDTP technology is the best available technique (BAT) to meet the project timescales. SL considers that there is no significant technological development needed to implement the existing technology. SCP is not a full replacement for SDTP as some existing key process components, including tanks, pipework and shielded flasks will be retained. SL has justified the use of the retained existing components for the operational life of SCP.

8. SL is planning to commence construction of SCP in June 2020 with the pouring of the concrete base slab. The SCP programme date for active operation is currently between 2028 and 2032. SL has categorised SCP as safety category B, significant nuclear safety proposal. ONR will decide subsequent regulatory permissioning hold-points as the project progresses.

2.1 LICENSEE'S PROPOSAL

9. SL has developed a safety case (ref. 2) that it considers provides sufficient confidence that the plant detailed design is sufficiently advanced to justify commencement of SCP construction and installation. SL plans to further develop the safety case to

encompass in more detail all phases of plant operation, including inactive and active commissioning, normal operation and decommissioning.

10. Overall, SL claims that the design and operation of SCP are adequately safe, the associated risks to the worker and public are as low as reasonably practicable (ALARP), and BAT has been used to meet environmental requirements. The Environment Agency considers BAT and so this is not considered further in this assessment.

11. SCP will operate alongside SIXEP and two pipe bridges and a link bridge will connect the two buildings and processes. SCP will be integrated into SIXEP and will be under continuous operator surveillance achieved via modification to the SIXEP's Central Control Room (CCR).

12. The design of SCP is based on SDTP but incorporates learning from experience from over thirty years of plant operation. SL has identified uncertainties with predicting the radioactive effluents arising from future operations on site, including aqueous effluents abated by SDTP and later SCP. These include uncertainties in the aqueous waste arisings generated during high hazard waste retrievals operations. SL has included contingencies within the SCP design to accommodate uncertainties in future effluent feeds, including low flow.

13. The volumes and chemical composition of SCP feeds is expected to change in the future. Whilst this could challenge the functionality of SCP, the plant design includes provision for an alternative treatment facility.

14. In outline SCP effluent treatment comprises of:

- Dosing the effluent feed with polyelectrolyte to improve the adhesion and capture of solids in the sand bed filters.
- Sand bed filtration of solids from the effluent.
- pH adjustment by carbonation of the filtered effluent. Carbon dioxide gas is used to reduce the pH to improve the performance of the ion-exchange (IX) resin.
- Ion exchange. Clinoptilolite resin (known as clino) is used to remove mainly strontium and caesium ions from the effluent stream.
- Routing the treated effluent to the SIXEP finals tank. Abated effluent is analysed and monitored and if compliant with the authorised discharge levels, discharged to sea.

15. In operation, SCP will generate solid intermediate level radioactive waste (ILW). This will mainly consist of spent IX resin, spent sand and solids backwashed from the sand filtration beds. Solid ILW from SCP will be transferred to SIXEP for storage in the existing bulk storage tanks (BST). SL is also planning to commission into service the medium active storage waste encapsulation plant (MASWEP) B tank to provide additional ILW storage capacity.

16. SL is evaluating the technology to recover and treat SIXEP and SCP solid ILW (ref.3). The facility is known as SIXEP waste management (SWM) and SL is intending for it to be available before existing ILW storage is full. The SCP design includes two 300m^3 capacity BSTs as contingency against SWM not being available before existing ILW storage capacity is full.

2.1.1 SCP DESIGN IMPROVEMENTS /DIFFERENCES

17. Generally, the SCP design replicates that of SDTP. Reference 2 safety case, section 3.3 outlines the significant differences between the designs of the two plants. These include the following:

- Seismic withstand: SL's external hazards assessment estimated the aerial and marine dose off-site as 0.75mSv. On this basis SL considers that SCP does not require seismic qualification. However, SCP will be designed and constructed to modern standards and as such will be an inherently robust plant.

  SL reviewed (ref.4) whether SCP operability following a seismic event would be valuable in terms of site-wide resilience. The review considered structural stability, processing operations and required recovery. The review confirmed that in SL's view there was no requirement for SCP to be designed and constructed for seismic withstand because:

  - Radiological assessment identified that SCP does not need seismic qualification.
  - SCP will be designed and constructed to modern standards and as such will be an inherently robust plant. SCP will be as likely to remain functional following a seismic event as SIXEP or the donor plants.
  - SCP post-seismic operability is not essential in terms of site-wide resilience because of the relative vulnerability of the donor plants.

- Additional IX column: Inclusion of an additional clino IX column will enable SCP to maintain treatment rates during IX bed renewal operations and provide operational flexibility. Currently SDTP process rates have to be reduced during bed renewal operations.

- Alternative IX column: SCP will have additional IX column, which will have the capability to deploy an alternative IX resin. The column could alternatively be loaded with clino to provide additional IX capability if needed.

- Bulk shielding: The SCP bulk shielding is based on providing protection against activity level of 380TBq/m^3, compared with the SIXEP design of 1000TBq/m^3. SIXEP operational experience is that activity levels are nearer to 10% of the design basis. SL considers that SCP will provide shielding for activity levels greater than current experience and allow for uncertainty in future feeds.
- C5 ventilation filter changes: in SCP C5 ventilation filters will be changed manually. SIXEP has the capability to remotely change filters, but in practice the filters are changed manually. This is because dose rates from SIXEP filters are low and the remote change facility is problematical and damages filters. SL expects SCP filter changes will be on a five year frequency, based on SIXEP experience. The proposal to manually change filters follows existing ALARP practices in SIXEP.

- C2 classification in filter rooms: Generally facilities on site have C3 extract provisions for contamination control in filter change rooms. For the SCP filter change facility, SL is proposing a C2 vent, as per the SCP services and general access areas. Access to filter change area will be via a sub-change room. The filter change area will be re-classified as C3 for the duration of filter change operations.

- Physical separation of backwash tank and pump rooms from the inactive chemical preparation areas. This is because under a fault condition radioactive liquor could back-migrate into the rooms, potentially exposing operators to ionising radiation.

- Alternative treatment facility: SCP design includes provision of process pipework connections for an as yet unspecified alternative treatment facility.

SL has also allocated land adjacent to SCP to site the alternative treatment facility.

- Hydrogen management: SCP is provided with emergency ventilation plugs to allow BSTs to vent hydrogen to cell in the event of loss of the vessel ventilation system. Unlike SDTP, SCP emergency discharges will be filtered.

- UV design and construction: SL has incorporated improvements to the UV design to address deterioration identified in SDTP UVs, which SL considers to be the main life-limiting component for SDTP.

- Valve maintenance: SIXEP process valves and pumps have proven to be very reliable, particularly when compared to the original design assumptions (ref SC). SIXEP has a fully shielded flask for valve and pump removal operations. SCP will use the same pump and valve design as SIXEP, and SL intends to use the existing flask for removal operations on all pumps and most valves.

18. The SCP design progressed on the basis of using the same high integrity plug valves that have been successfully proven in SIXEP. However, legal indemnity issues prevented SL from procuring the valves from the manufacturer, resulting in a significant delay to the project before the issue was resolved by developing an alternative source of valves.

2.1.2 HAZARDS AND RISKS

19. SL has assessed the potential for externally and internally initiated hazards for SCP. The higher consequence unmitigated faults that SL has identified which could potentially result in significant radiological risks to the public and workers include the following:

- Sea discharge of radioactive materials: SL has identified a fault that results in sea discharge of untreated radioactive effluent from SCP (0.1mSv unmitigated dose to the public via marine release. No dose to workers). This is similar to operations in SIXEP and requires failure of multiple lines of protection.
- Catastrophic failure of tie-in connections leading to loss of liquor containment (20-1000mSv unmitigated dose to workers. No dose to the public):
- Back migration of activity (20-1000mSv unmitigated dose to workers. No dose to the public).
- Loss of bulk containment of radioactive material following a major seismic event (0.75mSv unmitigated dose to the public and <1mSv to workers).

20. The SCP design includes engineering and administrative safety measures to control faults within the design basis and to provide the necessary defence in depth, to mitigate against any risk to workers or public safety

3 ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR IN CONSIDERATION OF THIS REQUEST

21. ONR's strategy for regulating the Sellafield site is identified in reference 5. The strategy's focus is on stimulating, facilitating and expediting hazard and risk reduction. Continued availability of the functionality currently provided by SIXEP is essential for hazard and risk reduction activities on donor plants. Uncertainty in the future operability of SDTP means that SCP is needed to maintain abatement of aqueous wastes arising from current and future hazard and risk reduction activities.

22. I have assessed SL's request for ONR Agreement under its arrangements for LC 19 (construction or installation of new plant) to commence construction of SCP. I have followed ONR's permissioning guidance (ref. 6) and permissioning strategy outlined in reference 7. I have utilised specialist ONR inspectors to assess the adequacy of SL's proposal. I am also cognisant of the findings of SL's oversight and challenge of the SCP project and the work undertaken by SL's Nuclear Independent and Oversight (NIO) function.

23. SL has requested ONR Agreement to commence SCP construction and installation. The commencement point is pouring of the base plate concrete, which is mainly a civil and structural engineering, and conventional health and safety activity. However, other ONR specialist inspectors were assigned to the permissioning activities as part of the strategy for early engagement. The main aims of early engagement were to ensure that there were no significant issues or shortfalls at the detailed design stage of the project, whose rectification through implementation of reasonably practicable options would be foreclosed by commencement of pouring the SCP base plate concrete. Early engagement also enabled ONR to identify any areas for future engagement.

24. ONR specialist inspectors have assessed the SCP safety case summary report and relevant supporting references. Where necessary, inspectors met with SL to obtain further evidence and discuss technical issues to inform their assessments.

25. The documentation supporting ONR permissioning of commencement of SCP construction is filed at CM9 4.4.21191.

4 MATTERS ARISING FROM ONR'S WORK

26. As part of my role as project inspector, I liaised with the ONR specialist inspectors assigned to this permissioning activity to develop the sample areas of SL's submission. Each inspector subsequently produced assessment scopes, which they shared to identify areas of specific and common interest.

27. This report covers ONR's assessment of the claims, arguments and evidence presented by SL to demonstrate that it can safely commence SCP construction and installation without foreclosure of safety options. The findings of each specialist inspector's assessment of the substantiated detailed design and safe operating envelope are summarised below.

28. Where inspectors identified shortfalls against regulatory expectations, recommendations have been made and incorporated as actions in the level 3 ONR Regulatory Issue 7940 associated with this permissioning activity. In all cases, inspectors considered that the nature and magnitude of the shortfalls are such that implementation of options to address them is not foreclosed by commencing pouring the SCP concrete base plate, and can be addressed by SL after Licence Instrument 528 has been issued.

29. ONR specialist inspectors have utilised ONR guidance, mainly the Safety Assessment Principles (ref. 24) and relevant Technical Assessment Guides, in forming their judgements on the adequacy the SCP safety case. Where necessary, the inspectors have also made reference to appropriate national / international standards and other relevant good practice.

4.1 CIVIL AND STRUCTURAL ENGINEERING (C&SE)

30. The C&SE inspector's assessment (ref. 8) of SL's proposals focussed on the key activities and associated arguments for:

- Design information and Loadings
- Building Information Modelling (BIM)
- External hazards and seismic qualification
- Proposals for design and construction of ground slab
- Shielding and containment
- Asset care
- Design reviews
- Decommissioning.

31. A conventional health and safety (CHS) inspector liaised with the C&SE inspector to provide CHS oversight of the civils construction.

Design information and loadings, and BIM

32. The inspector sampled the C&SE SCP basis of design and the design justification report, i.e. that the SCP will be designed and constructed to modern standards and as such will be an inherently robust plant. The inspector identified that the areas sampled met their expectations. This included: SCP design floor loadings are conservative when decommissioning loads are undetermined at this stage; dropped loads have been adequately considered; the selected loadings, combinations and utilisation figures are consistent with a conservative design.

33. In the inspector's opinion, there is nothing novel or obscure in SL's proposals for SCP design and construction.

External hazards and seismic resilience.

34. The inspector noted that during early engagement on SCP ONR was provisionally satisfied that a non-seismic qualification of SCP was appropriate because of its inventory and low release fractions and was a sensible and pragmatic approach (ref.9). However, ONR noted that the programme/site-wide view had not been explicitly considered and this should be clearly understood and articulated. Notwithstanding ONR's previous position, the inspector's assessment included detailed consideration of the adequacy of SL's evidence that SCP does not need to be seismically qualified.

35. The SCP Safety Case summary report claims that the unmitigated aerial and marine dose to the public is a total of 0.75mSv. The inspector noted that this is below 1mSv criteria for seismic design and hence SCP does not require any seismic qualification.

36. The inspector consulted with the ONR Fault Studies Specialist who has confirmed that in their opinion, SL claims that the total 0.75 mSv is justifiable and underpinned. In the C&SE inspector's opinion the aerial dose figure contribution of 0.47mSv has a sufficient margin below the 1mSv threshold as to provide an adequate allowance against errors.

37. The inspector challenged SL to demonstrate how it anticipated SCP would fail in a seismic event. SL's subsequent response met the inspector's expectations for how a steel frame and reinforced concrete cell would behave. The inspector considered that the SCP design would be expected to further restrict any dose spread and provides a further degree of conservatism in SL's claim of an unmitigated 0.47 mSv aerial dose to the public.

38. The inspector is content that from a C&SE perspective, impacts arising from a seismic event had been adequately considered in the SCP design.

39. In respect of continued operation after a seismic event, the inspector notes that SCP is likely to remain as functional as SIXEP or other donor plants, and as such judges this to be acceptable. This point is also considered by the ONR project inspector.

40. SL states that although seismic qualification is not required the structure will be designed and built to modern standards and as such will be ALARP. The inspector assessed documentary evidence supplied by SL to support the ALARP claim and judges that it meetsONR's expectations.

41. For other external hazards wind, flood, lightening, extreme temperature, snow loading and aircraft crash the inspector sampled the SCP hazard analysis. The inspector's judgement agrees with SL claims that no extra provisions are required beyond the application of RGP and that the risks are ALARP.

Proposals for design and construction of ground slab, shielding and containment; asset care; design reviews; decommissioning

42. The inspector sampled details of the following:

- The SCP raft and ground slab designs. The design provision meets the inspector's expectations.
- SL's justification for SCP radiological shielding provided by the civil structures, including comparison with the existing SIXEP facility. Overall, the design meets the inspector's expectations.
- SL's proposals for asset care of the SCP civils structures, particularly taking into consideration the 50 years design life. The inspector identified that the SCP asset care requirements were being developed by the project. SL's proposals meet the inspector's expectations as they consider that SL's inspection arrangements are well established and accepted by ONR as demonstrating RGP.
- SL's control and management for SCP design reviews. Based on the evidenced sampled, the inspector concluded that SL has an adequate system of design review and independent assurance checks.
- SCP decommissioning philosophy document, including provision for decommissioning within the plant design. The inspector judges that SL's general approach and philosophy met their expectations for this stage of the project.

Conclusion

43. In conclusion the C&SE inspector is satisfied with the claims, arguments and evidence laid down within SL's safety case.

44. In the inspector's opinion, from a civil engineering perspective;

- SL has made an adequate safety case argument to justify not undertaking seismic design of the plant because of the low dose rates, the robust process cell construction and additional structural enhancements to satisfy an ALARP argument, in accordance with ONR SAPs and TAGs.
- SL has undertaken an appropriate design process that has included single and multidiscipline design reviews and undergone challenge from SL's Independent Structural Analysis function, INSA and MSC.
- SL has met RGP for this type of civil engineering proposal. For the robust, conservative SCP design, SL has provided sufficient evidence to support the claim that, from a civil engineering perspective, risks will be reduced to ALARP when compared with ONR safety assessment principles (SAP) and technical assessment guides (TAG).

Recommendations

45. The inspector recommends that from a C&SE perspective, ONR agrees to commencement of SCP construction.

46. The inspector also recommends that the ONR SCP project inspector should consider undertaking a readiness inspection prior to commencement of the reinforcement cages' construction. This aligns with learning from experience from ONR readiness inspection undertaken as part of the recent permissioning of commencement of construction of SRP (ref. 23).

4.2 MECHANICAL ENGINEERING (ME)

47. The mechanical engineering specialist inspector's assessment (re.10) considered how the mechanical engineering structures, systems and components contribute to delivery of containment and shielding. The inspector focused on:

- Containment – the ability of the ventilation systems to filter airborne discharges and management of hydrogen concentration levels within the BSTs to prevent deflagration [rapid combustion propagation] occurring.
- Shielding – potential for mechanical lifting and handling operations to damage or compromise shielding.

48. Overall, the inspector is satisfied that SL has applied RGP to the design of the SCP ventilation system to ensure that radioactive species will be adequately contained and hydrogen in-air concentrations be maintained at safe levels within the BSTs.

49. Lifting systems (e.g. overhead cranes) are large heavy masses that have a major influence on the design of the civil structure. The inspector therefore assessed the two SCP cranes to confirm that they had been adequately specified and configured to reduce risk ALARP, and ensure that commencement of construction does not foreclose implementation of any further reasonably practicable measures to reduce risk

50. The inspector judges that the SCP cranes have been appropriately specified and the risk of the crane mass increasing sufficiently to detrimentally impact on building design is very low.

51. The inspector assessed the pump and valve flask and associated components (bogie and lifting beam). The flask provides shielding for contaminated components. The inspector identified three shortfalls: one associated with the pump and valve flask drop withstand; one associated with the flask transfer bogie safety function and classification; and one associated with the lifting beam design. These shortfalls (referred to as recommendations by the inspector) will be included as actions in Regulatory Issue 7940.

Conclusions

52. The inspector is satisfied with the mechanical engineering aspects of the claims, arguments and evidence laid down within the SL's safety case.

53. The inspector found no significant gaps against RGP.

Recommendation

54. The inspector recommends that, from a mechanical engineering perspective, ONR should issue Agreement for SL to commence construction of SCP.

4.3 FAULT STUDIES (FS)

55. The fault studies specialist inspector's assessment (ref.11) focussed on whether SL has undertaken suitable analysis to demonstrate that the radiological risks associated with

operation of the facility, once constructed, have been identified and will be adequately controlled to ALARP. Taking the maturity of the design into account, the inspector sampled the SCP safety case to inform his judgement as to whether SL has:

- Performed a comprehensive fault identification and analysis process to inform limits and conditions and the safe operating envelope.
- Identified suitable and sufficient safety measures and appropriately classified these measures.
- Considered the defence in depth principles and the resilience of the facility to potential faults (including seismic events).

56. The inspector focused on sampling the processes SL employed to identify and assess the radiological hazards. The inspector recognised that the design of SCP is similar in many ways to the equivalent SIXEP facility. They therefore focussed the fault assessment on:

- Two faults where the inspector considers SL has adopted an alternative approach to SIXEP and where public or worker unmitigated consequences are highest. These are: the seismic safety case; operations associated with backwash room access. For the former SL assessed the aerial and marine dose to the public as 0.75 mSv. For the latter, SL assessed the potential consequences in the 20-1000 mSv range, albeit with significantly low event frequencies.
- Faults associated with lifting operations (as SL is applying a new methodology in this area).
- Radioactive leaks from primary containment.

57. The inspector's main aim was to establish if there were any fault studies related issues that SL would need to resolve before commencing SCP construction and installation.

Fault analysis techniques

58. The inspector noted that SAP FA.1 places the expectation that fault analysis should be carried out comprising suitable and sufficient design basis analysis (DBA), probabilistic safety analysis (PSA) and severe accident analysis (SAA) to demonstrate that risks are ALARP.

59. The inspector identified that SL had undertaken design basis analysis in accordance with its design basis accident analysis (DBAA) processes, which they consider to be an appropriate analysis technique to employ. The inspector did not consider SCP to be a complex plant with a high sensitivity to failure modes leading to high consequence events that would warrant a more thorough PSA than SL had adopted. The inspector was content with SL's current position and did not consider this matter further.

60. The inspector sampled the SAA considerations for SCP. Overall the inspector considered that undertaking a SAA was not proportionate for SCP, and considers that SL has undertaken proportional DBA, SAA and PSA analysis.

Fault Identification and Definition of the Plant Design Basis

61. The inspector identified that SL has adopted a structured approach to its fault identification using a combination of SCP specific hazards studies and faults identified in the SIXEP safety case. Based on the sample considered, the inspector is satisfied with the approach taken by SL to identify faults within the design basis and their consequences, to inform identification of safety measures for further development within the safety case.

Fault Sequence Groups

62. The inspector sampled the fault sequence groups with the highest radiological consequences for workers and the public. These being back migration of activity to the backwash tank and pump rooms; loss of primary containment of liquor from vessels and pipework; SCP seismic nuclear safety case.

63. The inspector identified that SL has sought to design a number of different systems to protect against back migration to the backwash tanks and pump rooms. The detailed design of these systems is still being finalised, so the inspector was not able to form overall judgement on the adequacy of protection. The inspector made a recommendation associated with the protective measures identified to protect the operator prior to and during entries into the SCP backwash tank and pump rooms. The recommendation will be included as an action in Regulatory Issue 7940.

64. The inspector considered that for loss of primary containment, SL has made adequate design provision and categorisation of the primary and secondary containment; has applied relevant good practice in identifying independence from the control system and an interlock to stop transfers within the SCP design; has made adequate arrangements to protect against aerosol release from a leak. The inspector has made a recommendation associated with the safety classification of the in-cell leakage detection systems, which is included as an action in Regulatory Issue 7940. The leakage detection system forms part of the overall defence in depth, with primary and secondary containment providing the main barriers.

65. The inspector sampled the following areas to inform their assessment of the adequacy of the SCP seismic withstand.

- The dose consequence claims and comparison against ONR guidance. ONR civil engineering inspector considered the adequacy of the building design in maintaining structural stability and containment during/following seismic events.
- The post-seismic dose analysis. SL assumes that the building and vessel/pipework integrity is lcompromisedand contents are free to escape, subject to conservative release factions for solid radioactive material.

66. The inspector is satisfied that SL adopted an approach which uses a conservative bounding specification for its consequence calculations. The inspector noted that ONR had previously judged (ref.9) SL's approach to crediting limited inventory and release fraction as adequate. The inspector restricted the assessment to the basis of a number of assumptions in relation to SL's approach

67. The inspector concludes that, from a fault studies perspective, SL's intention to design and construct in accordance with modern standards for industrial facilities satisfies relevant ONR guidance. The inspector excluded consideration of the holistic aspect of SL's seismic withstand argument. This aspect is addressed by the civils and ONR project inspector, which are in section 4.1 and 4.10 of this report.

Lifting operations

68. The inspector sampled the fault studies aspects of SCP lifting operations. The inspector is satisfied that SL has identified a reasonable and comprehensive list of lifting related fault sequences relevant to SCP. The inspector identified that the lifting safety case also draws in consideration of non-radiological hazards in attempting to draw a balanced case. In this respect the inspector regards the approach taken for development and presentation of SL's safety case as good practice and is in accordance with ONR guidance.

69. The inspector is aware that whist some details of the crane design and safety case are still being developed, the inspector considers that the initial basis for SL's analysis of lifting operations is reasonable. The inspector recommends that ONR maintains engagement on

SL's development of the SCP lifting operation safety case. The recommendation will be added as an action to Regulatory Issue 7940.

Conclusions

70. From a fault studies perspective the inspector concludes that:

- SL's overall approach to fault analysis is appropriate.
- With the exception of one minor shortfall (captured as a recommendation), the inspector is satisfied with the claims, arguments and evidence concerning maintaining containment of radioactive material.
- They have sufficient confidence that the recommendation associated with the lifting operation safety case can be addressed during development of detailed design crane category management approach.
- The safety case adequately supports SL's view that formal seismic qualification of the facility is not required to manage the risk of a release of radioactive material from SCP following a seismic event.
- Overall, from a fault analysis perspective, the inspector has confidence that SL will be able to demonstrate that risks arising from SCP during operation will be reduced to ALARP.

Recommendation

71. From a fault analysis perspective the inspector supports ONR's project inspector recommending permission to commence construction of the SCP facility.

4.4 STRUCTURAL INTEGRITY

72. The structural integrity specialist inspector's assessment (ref.12) focused on the evidence to support SL's safety case claim that SCP is designed to keep radioactive material adequately contained, and the risk of accidental release is ALARP.

73. The assessment focused specifically on SCP process primary containment systems and components, specifically pressure vessels, pipework and tanks.

74. The inspector sampled SL's proposals for the design and construction of:

- The seven universal vessels (UV) (IX and sand bed vessels) and two BSTs (300m^3 capacity, atmospheric pressure tanks). This is because the SDTP UVs are judged by SL to be the life-limiting components of the plant; filled BSTs will have the biggest inventory of ILW on SCP.
- The process pipework because pipework failure presents single point vulnerabilities to SCP operation.
- The process valves because SL cannot procure the valves that have proven to be very reliable on SIXEP.
- Tie-in connections and retained SDTP components. These components have already been in service for approximately 35 years and could need to be in use until 2060. In addition, catastrophic failure of the inlet pipework tie-in connection has potential radiological consequences (20-1000 mSv range, albeit with significantly low event frequencies). The tie-in connections will be subject to appropriate engineering controls during fabrication to support the safety function classification of the pipework. This will include control of welding operations and examination, all of which will be undertaken to appropriate national standards.
- Deterioration mechanisms. Deteriorations need to be adequately understood and accounted for in the SCP design, particularly as the plant has a 50 years design life. Also most process systems and components will not be accessible once the plant is in active operations.

75. The inspector is satisfied that SL has identified all reasonably foreseeable deterioration mechanisms and included consideration of cliff-edge effects. For fatigue (failure mechanism for SDTP UVs), SL has improved the UV design and also introduced valve closure times to control pressure surge and differential pressure. Other deterioration mechanisms are slow and predictable (i.e. corrosion and solid particle induce erosion). The primary containment components will also be subject to routine in-service inspection, which will include inspection for indications of deterioration.

76. Overall, the inspector judged that SCP UVs, BSTs, pipework and process valves have been appropriately and conservatively designed. The inspector considers that SL has set appropriate limits and conditions for primary containment in accordance with national standards.

77. The inspector also considers that SL has provided sufficient evidence that the reasonably foreseeable SCP deterioration mechanisms have been identified and taken account of in the plant design. However, the inspector identified a shortfall associated with substantiation of retained SIXEP components. In the inspector's opinion, SL has not provided sufficient evidence from in-service inspections for four of the retained components to support the judgement that they were suitable for continued service in SCP. SL judged that the condition of the four components could be derived from inspection findings on other, comparable components. However, given that the components could be in use for over 50 years, the inspector considers that SL should provide further evidence to support its judgment. The shortfall is included as an action in Regulatory Issue 7940.

78. The inspector is satisfied that SL has developed and is implementing an adequate programme to procure SCP process valves. The inspector considers that SL is adopting a conservative approach by producing and testing prototype valves prior to manufacture of the SCP valves.

Conclusions

79. From a structural integrity perspective the inspector concludes that:

- SL has provided sufficient evidence to support the main claim in SL's safety case that the design and operation of SCP will be adequately safe, and the associated risks to worker and public will be ALARP.
- SL has sufficient evidence to support the claim that SCP is designed to keep radioactive material adequately contained, and the risk of accidental release will be ALARP.

Recommendation

80. The inspector recommends that from a structural integrity perspective, ONR should issue Agreement for SL to commence SCP construction and installation.

4.5 CHEMICAL ENGINEERING

81. The chemical engineering specialist inspector's assessment (ref.13) focused on:

- Process design and selection.
- Unit operation/ equipment design.
- Safe operating envelope, and
- Selection of systems and components.

82. The inspector's sampling strategy targeted the following areas to gain evidence for the:

- Prevention of activity breakthrough;

- Universal vessel failure; and
- Formation of flammable atmospheres in the Bulk Storage Tanks.

83. For activity breakthrough and UV failure, the inspector sought evidence that the radioactive source term had been adequately identified and conservatively assessed by SL, and thatthe chemical process design accommodated both normal and fault conditions. The latter included assessment of pressure surge. The inspector sampled evidence of how SL assessed the risks associated with hydrogen formation, and how the risk was minimised to ALARP in the SCP design.

84. Overall, the inspector considers that the areas sampled have been adequately addressed by SL. However, the inspector made two recommendations associated with refining the chemical process limits and conditions. The recommendations are included as actions in Regulatory Issue 7940.

85. The inspector is also content that SDTP is proven technology for treatment of donor plants' aqueous waste streams and provides a fit-for-purpose design choice for SCP. Nevertheless, the inspector requested further evidence regarding other potential process treatment technologies that could be implemented if they offer an ALARP benefit. The inspector also requested that SL provides further documented evidence to adequately demonstrate that the overall SCP lifecycle risks have been optimised and are ALARP. This shortfall is included as an action under Regulatory Issue 7940.

Conclusions

86. The chemical engineering inspector is satisfied that the safety case:

- Provides sufficient confidence that the SCP process design is ready for construction and installation.
- Adequately describes how the chemical engineering safe operating envelope will be formed and that appropriate engineered and operational safety measures have been identified to ensure safety during normal operations, and under fault conditions.
- Incorporated relevant experience gained from over 30 years of operating SIXEP.

Recommendation

87. The inspector, from a chemical engineering perspective, supports ONR agreeing to commencement of SCP construction and installation.

4.6 INTERNAL HAZARDS

88. The internal hazards inspector's assessment (ref.14) had four main aims:

- To determine if SL has sufficient evidence to support the claim that SCP is designed to keep radioactive material adequately contained, and the risk of accidental release is ALARP.
- To determine from early engagement if there are any internal hazards related issues that SL would need to resolve before commencing SCP construction and installation - in particular pour of concrete.
- To determine if SL has sufficient evidence to support the continued operation of existing SIXEP systems and components that will form part of the SCP process.
- To determine if, from an internal hazards perspective, the inspector can recommend ONR issuing Agreement to commence SCP construction and installation.

89. The inspector focused on internal hazards which have been identified within the safety case as being DB2 faults to the public (0.1mSv marine release). The inspector chose to sample fire and hydrogen deflagration/ detonation hazards.

Fire

90. The SCP safety case identifies two design basis faults (DB2) involving fire, both of which the inspector sampled.

- Failure of process valve configuration leading to unabated effluent bypassing the IX vessels, this would lead to a marine release of radioactive effluent a significant public dose. The scenario considers a fire which causes failure of the valve control system leading to abnormal opening of the valves.

- Loss of function of the IX columns from bed collapse arising from excessive overpressure across the bed support plate could lead to unabated effluent passing to the SIXEP final collection tank. The fault could be initiated by a fire in the control system leading to over-pressurisation from over-speeding pumps. The inspector was content that SL had taken account of the risk of bed collapse in the UV design.

91. The inspector assessed SL's evidence relating to fire-related failure of process valve configuration leading to unabated effluent bypassing the IX vessels. Valve configuration control is one of the two lines of protection against sea discharge of untreated effluent (unmitigated 0.1mSv dose to the public). For fire to challenge the valve configuration line of protection, simultaneous fires would need to occur in SCP and SIXEP building, which SL claims to be not credible but without systematic justification. The fire does not however, challenge the second protection measure, which is the gamma activity monitor/trip associated with the existing SIXEP sea discharge tank.

92. The inspector judged that there were two areas where this claim could be challenged. Firstly, the link bridge is not protected by doors with a fire withstand claim against them, and secondly that burning debris could be propelled from one building to the other and thus lead to simultaneous fires. Neither of these two scenarios is included in SL's safety case, which represents a shortfall against ONR guidance. The inspector judges that correction of this concern will require revision to the fire safety case and potentially a minor design change. In the inspector's opinion neither of these modifications will be foreclosed by commencing SCP construction and installation.

93. The inspector also found that the existing fire detection and alarm system in SIXEP (where SCP valve controls are located) had been judged as inadequate during a previous ONR inspection. This shortfall is the subject of ONR Regulatory Issue 7483. SL is currently addressing the action associated with the Issue.

94. Overall, the inspector identified two recommendations associated with the shortfalls in the nuclear fire aspects of the SCP safety case. These are included as actions in regulatory Issue 7940.

Hydrogen

95. Operating the SCP will generate the potential for a flammable hazard from hydrogen generated via radiolysis of water. The inspector focused on SL's analysis of hydrogen deflagration and hydrogen detonation for SCP.

96. Overall, the inspector considers that SL has provided adequate deterministic assessment and defence in depth protective measures both normal and fault conditions that could give rise to the risk of hydrogen deflagration / detonation. However, the inspector considers that SL has not adequately considered the consequential effects of missile generation and

vibration on SCP resulting from such events. Although these events could challenge the primary containment within the building, they would not significantly challenge the concrete structure which provides secondary containment.

97. The proposed pressure testing regime for primary containment components was also found to not meet RGP for explosion withstand testing.

98. The inspector therefore makes three recommendations associated with SL's assessment of hydrogen deflagration, explosion testing and detonation on SCP. The recommendations are included as actions in regulatory Issue 7940.

Conclusions

99. The internal hazard inspector concludes that:

- SL has provided sufficient design details of the process and plant to allow identification of the internal hazards and assessment of the safety case for the concrete structure of the proposed SCP building, and demonstrates the risk of accidental radiological release is ALARP.
- SL has provided sufficient evidence to support the claim that the SCP concrete building structure is designed to keep radioactive material adequately contained.
- Shortfalls and associated recommendations related to SL improving fire protection and explosion have been identified whose implementation would not be foreclosed by commencement of SCP construction.

Recommendation

100. The internal hazards inspector recommends that, from an internal hazards perspective, ONR should issue Agreement for SL to commence SCP construction and installation.

4.7 NUCLEAR LIABILITIES

101. The nuclear liabilities inspector's assessment (ref.15) focused on the following areas, taking into account that SCP is in the design stage:

- Safe management of secondary and solid and radioactive waste in SCP.
- Preparation for decommissioning as appropriate for the current stage in the facility's lifecycle.
- Interface between SCP and other plants, projects, and strategies on the Sellafield site.

Secondary radioactive waste arisings

102. Since the online process in SCP will be the same as that already in use in SIXEP, SL assumes all secondary radioactive waste arisings will be disposed of through existing SIXEP routes. The inspector considers this to be a reasonable assumption based on the history of operating a broadly similar plant and process.

103. Overall, the inspector judges that for this pre-construction phase, SL has sufficiently demonstrated that secondary waste arisings will be segregated and minimised in line with ONR expectations.

Solid radioactive waste

104. SL plans to export solid waste (sludge, sand, IX) from SCP to the existing SIXEP BSTs. The two contingency SCP BSTs will only be used if SWM is not available when

the SIXEP BSTs reach capacity. In principle this will minimise the risk that the SCP tanks will become contaminated and thus need to be disposed of as radioactive waste.

105. The inspector made a recommendation associated with storage of radioactive sludge waste. The inspector's recommendation is included as an action in Regulatory Issue 7940.

Assessment of decommissioning

106. In the inspector's opinion decommissioning has been considered at a suitable level of detail for a facility that has not yet been built. SCP has been designed so that radioactive waste is minimised and that all plant and equipment is physically accessible for removal. The inspector judges that the decommissioning philosophy meets ONRs expectations as set out the SAPs.

Conclusions

107. The nuclear liabilities inspector concludes that:

- SL has demonstrated it has adequately considered the safe management of radioactive waste and planning for decommissioning suitable for this stage in the lifecycle of SCP. SL is progressing work on estimating waste arisings and implementation of future arrangements for management of wastes arising from SIXEP and SCP.

Recommendation

108. The inspector recommends that, from a nuclear liabilities perspective, ONR should issue the Agreement for SL to commence SCP construction.

4.8 HUMAN FACTORS

109. The inspector's assessment (ref.16) focused on the areas they considered HF to have the greatest potential impact in terms of nuclear safety.

110. The inspector identified that the SCP safety case does not make extensive claims on the operator with regard to nuclear safety. It does however identify a small number of explicit operational claims, comprising eight required Operator Instructions and nine Operator Assumptions.

111. In considering the operational human-based safety claims, the inspector identified that SL claims SCP has been designed so that it can be operated safely. SL also claims that it has undertaken a systematic and rigorous assessment of the design and that the hazards and risks are understood, and where necessary, reduced human factors aspects of the design to ensure the risk is ALARP. SL is of the opinion that SCP has been designed to support reliable task performance, taking into account the physical and psychological characteristics of the intended users.

112. Given the above, the inspector focused on the following areas:

- Human factors integration.
- Concept of operation, including allocation of function.
- Workspace and workplace design.
- Claims on the human.
- Migration phase from SIXEP to SCP and future operations.

113. Overall, the inspector is broadly satisfied that SL has taken a systematic approach to integrating HF into the detailed design of SCP. However, the inspector identified a

shortfall associated with some limitations in the scope and adequacy of proposed human factors integration. This relates to four specific areas: planned verification of user requirements, particularly in the shared SIXEP/SCP control room, migration arrangements from SIXEP to SCP, underpinning changes in the arrangements between the existing facility and the new facility and HF Support to pre-operations with particular emphasis on training arrangements and the provision and communication of operating instructions. The shortfall is captured as a recommendation that is included as an action in regulatory Issue 7940.

114. The inspector did not identify any significant concerns from concept of operation or allocation of function. For workspace and workplace design, the inspector judges that SL is progressing work on these areas as part of the SCP project programme and commencing construction will not impede this. However, the inspector identified a shortfall associated with target users capabilities, and physical and cognitive characteristics of work tasks. The shortfall is captured as a recommendation that will be included as an action in regulatory Issue 7940.

115. The inspector gained sufficient confidence that the claims on the operator are feasible, achievable, and can be substantiated. The inspector identified that proposals for managing migration between SIXEP and SCP were in the early stages of development, and that it is a topic for continued regulatory attention post-permissioning.

Conclusions

116. On the basis of the evidence sampled, the inspector considers that SL has taken a structured and systematic approach to the consideration of HF in relation to the suitability of design and SL's safety case for its SCP facility. The inspector is broadly satisfied that the operational contribution to safety is understood and that the operator claims are reasonable and justifiable.

117. The inspector gained sufficient confidence that the design has accounted for people in addition to plant and processand, in particular, those new design aspects introduced by SCP's design, build upon and improve the extant SIXEP design.

Recommendation

118. The inspector recommends that, from a human factors perspective, ONR should issue Agreement for SL to commence SCP construction and installation.

4.9 ELECTRICAL CONTROL AND INSTRUMENTATION ENGINEERING

119. The control and electrical engineering (EC&I) inspector's assessment (ref.17) focused on:

- SCP leakage detection systems.
- Protection of workers from exposure to ionising radiation in the event of back migration of process liquor via the backwash tank and pump rooms.
- SCP control system.
- Wireless Communications.

SCP leakage detection systems

120. The inspector identified an issue regarding the safety designation of leakage detection system and sought further evidence from SL to support classifying this system as safety related equipment (SRE) and not safety mechanism (SM); the former being a lower safety classification. The inspector judges that SL has not provided sufficient evidence to justify the proposed safety designation of the leakage detection system.

This may be a concern for future reliability of the system, as an SM designation will attract more rigorous maintenance and testing. The inspector has raised a recommendation against this shortfall, which is included as an action in Regulatory Issue 7940.

Backwash operation

121. The inspector identified that SCP design has two protective measures (referred to by SL as basket safety measures (BSM)) for protecting operators from exposure to ionising radiation in the event of backwash into the backwash tank room and backwash pump room, during maintenance operation. These are BSM 1: prevent access via gamma interlock monitors and BSM 2, duly authorised person control of access key, which is a required operating instruction with a supporting engineering feature.

122. Based on the information available for this assessment, the inspector is of the opinion that the safety designation of the EC&I engineering feature supporting BSM2 is not adequate to support the reliability claim. The inspector therefore raised a recommendation against the shortfall which is included as an action in Regulatory Issue 7940.

Plant control system; Use of wireless communication

123. At the current stage of the project, the design of the plant control systems is incomplete. Because of the importance of this system in future SCP operation, ONR will continue to engage with SL on this topic after this permissioning and before commissioning of the plant.

124. Further, to inform future ONR SCP engagement, the inspector has raised an assessment recommendation for SL to provide evidence of the cyber security aspects of the plant control system.

125. SL intends to use wireless communication in some of the applications in SCP. The inspector is satisfied that wireless communications are not supporting any SCP safety or safety related functions and judges that SL's approach is adequate for SCP.

Conclusion

126. The EC& I inspector has raised recommendations, all of which the inspector considers can be addressed by SL post-permissioning. The recommendations are included as actions in Regulatory Issue 7940.

Recommendation

127. The inspector recommends that from an electrical control and instrumentation engineering perspective, ONR should issue Agreement to enable SL to commence construction of SCP.

4.10 PROJECT INSPECTION

128. In accordance with the ONR/Environment Agency (EA) memorandum of understanding (MoU), I consulted with the relevant EA inspector over whether EA has any objections on environmental grounds to ONR agreeing to SL commencing SCP construction and installation. The EA inspector has confirmed that EA has no objection to ONR agreeing to SL's request (ref.18).

129. I confirmed SL's governance and oversight of SCP has included consideration by the relevant Management Safety Committee (ref. 19).

130. I sampled the Independent Nuclear Safety Assessment (ref. 20) for SCP and identified that it included assessment of the seismic withstand requirements, radiological shielding design, and tie-in connections. INSA accepted the documents reviewed with no reservations on the proviso that the target dose uptake of 1mSv/year for other workers and the public is included in the dose uptake and ALARP assessment. SL has addressed these points, which have been assessed by ONR and found to be acceptable.

Seismic withstand

131. SL has judged that SCP does not require seismic qualification. In reaching this decision SL took account of radiological and strategic requirements. The former point has been assessed primarily by ONR fault studies and civil engineering specialists, and found to be adequately justified. The latter relates to post-seismic operability of SCP in terms of site-wide resilience to a seismic event.

132. I reviewed SL's safety case document presenting the strategic seismic requirements for SCP (ref.4). In outline, SL claims that SCP will be at least as likely as the donor plants to remain operational (or be as easily recoverable to operability) following a seismic event. The donor plants were not designed for seismic loads, but have since been assessed by SL as being able to maintain safe conditions after a 0.125g event. Also, SL judges that an operable SCP would not significantly mitigate the impact of a seismic event across site.

133. SL's strategic seismic review included consideration of the severe accident analysis summary report for Sellafield pond plants. There is no reliance on SIXEP functionality to respond to an emergency situation. This has been translated to SCP. Overall, SL concludes that post-seismic operability of SCP is not essential in terms of site-wide (strategic) resilience to a seismic event.

134. Overall, I consider SL's claim on SCP post-seismic event availability in relation to that of donor plants to be reasonable. In coming to this conclusion, I have spoken with ONR civil engineering specialists and taken account of ONR's assessment of the seismic withstand of MSSS (ref.25), a SCP donor plant. I chose MSSS because it is classified as an intolerable plant for which removing the high hazard and risk is a national priority.

135. I subsequently sampled SL's governance and oversight of the strategic decision not to seismically qualify SCP (ref. 20). I identified that the decision has been endorsed by the SIXEP Strategic Authority and the Sellafield Resilience Technical sub-group. I also identified that as part of SL's internal governance reviews, seismic qualification was challenged during the external hazards review. The arguments not to seismically qualify SCP were accepted by the reviewer. Overall, I am satisfied that SL has delivered adequate oversight and governance of the decision not to seismically qualify SCP.

136. I reviewed the ALARP justification for not seismically qualifying SCP (ref. 21). I identified that the justification outlines pessimistic assumptions underpinning the plant design. The report also identifies robustness provisions within the building design, some of which are additional to design standard requirements. It also outlines the significant sacrifice in terms of time and cost of seismically qualifying SCP.

137. SL reiterates that as the building has been designed to appropriate modern standards. Designing SCP to be fully recoverable after a 0.125g seismic event or greater would, SL judges, have a much greater impact on costs and programme delivery. I have experience of permissioning operation of seismically qualified plant on civil nuclear power stations and consider that SL's ALARP justification is reasonable.

138. Overall, I consider that SL has provided adequate evidence to support the claim that there is no strategic requirement to design SCP to withstand a seismic event. I , along with other specialist inspectors, all consider that SL has provided adequate evidence to support the claim that the risks arising from a seismic event have been reduced so far as is reasonably practicable for SCP.

5 CONCLUSIONS

139. Overall, based on the findings of my review of SL's safety case submission and the ONR specialist inspectors' assessments findings, I consider that SL has:

- Provided evidence that the risks to workers and the public arising from the construction, installation and operation have been adequately identified and will be controlled so far as is reasonably practicable.
- Provided adequate evidence that the proposal has been subject to an adequate level of internal and independent oversight, governance and challenge in accordance with SL's established Licence Condition compliance arrangements.

140. ONR's assessment of SL's proposal identified a number of shortfalls against relevant good practice. In each case the specialist inspectors judge that the nature and magnitude of the shortfalls and associated recommendations, is such that implementation of options to address them, would not be foreclosed by the commencement of the SCP concrete base pour. As such, they do not prevent ONR agreeing to SL commencing SCP construction and installation.

141. The shortfalls and recommendations are incorporated as actions in the level 3 Regulatory Issue 7940 associated with this permissioning activity. ONR will use the Regulatory Issue to manage SL's responses to the actions, in accordance with regulatory guidance. ONR Agreement to commence SCP construction and installation will not foreclose SL providing adequate responses to the Regulatory Issue actions.

6 RECOMMENDATION

142. I recommend that ONR issue Licence Condition 19 (construction or installation of new plant) Licence Instrument 528, Agreement to Sellafield Limited commencing construction of SCP.

7 REFERENCES

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