

4. RECOMMENDATIONS

4.1 OVERALL FINDING

A number of recommendations for improvements to the Applicant's safety analysis report have been made in the Regulatory Branch assessment of the PSAR (in section 3). These recommendations arise from the technical assessment of the Application against the ARPANSA principles [ARPANSA 2001a] and criteria [ARPANSA 2001b], other experts' findings such as in the international peer review and consultants engaged by Regulatory Branch, for example [Johnson 2002], and consideration of matters raised in public submissions and the public forum. As described in the Introduction, the safety case made by the Applicant reflects the level of design and analysis at the time of making the Application and this is expected to be commensurate with the stage of the replacement research reactor project ie. prior to obtaining an authorisation to commence construction. In this sense it is a "preliminary" safety analysis report which conforms to Regulatory Assessment Principle 21.

The matters identified in the recommendations documented in this report are intended for the Applicant to consider and to implement accordingly. The ARPANSA CEO will need to be satisfied in any further submissions or applications made to ARPANSA, such as those to construct an item important for safety (regulation 54 condition) or to obtain a licence to operate, that these recommendations have been appropriately taken into account. The Regulatory Branch assessment finds that while these matters may not have been fully considered in the current Application, the safety case presented does adequately bound the additional matters raised such that safety can be achieved in the as constructed facility. Consequently, the recommendations arising from the regulatory assessment, taken individually and together, do not represent an impediment to the CEO in making a positive decision to issue a Licence to Construct.

Regulatory Branch assessment overall finding: The Regulatory Branch assessment finds that the depth of detail of the design and safety analysis in the Application for a Licence to Construct is sufficient to demonstrate that the facility could be operated safely (should an operating licence eventually be granted) provided that the facility is constructed according to the Applicant's stated intentions in the Application and in compliance with any licence conditions and with appropriate consideration of any Regulatory Branch assessment recommendations, should a construction licence be granted.

4.2 RECOMMENDATIONS

The following is the compilation of recommendations made throughout this Regulatory Assessment Report. These are titled and numbered according to the section in which they have been made.

2.3 Detailed description of the facility and the site

R1. Recommendation 2.3-1: The Regulatory Branch assessment recommends that the CEO amend the Licence to prepare a site to include the revised description of the site as given in the Application figures 1 and 2.

R2. Recommendation 2.3-2: The Regulatory Branch assessment recommends that the Special Condition in the siting licence requiring the licensee to ensure that there are no changes to the boundaries or use of land within the Buffer Zone unless the CEO ARPANSA has approved such change in his absolute discretion, be carried into any construction or operating licence.

2.4 (a) Arrangements for Maintaining Effective Control

R3. Recommendation 2.4(a)-1: The Regulatory Branch assessment recommends that the CEO make the following a condition of any licence to construct:

The licence holder must provide to the CEO for approval the details of the plant staffing structure and arrangements for selection, training and accreditation of replacement reactor operating personnel, within a timeframe agreed with the CEO.

R4. Recommendation 2.4(a)-2: Any application for a licence to operate should include a mature, peer reviewed Probabilistic Safety Assessment with evidence that it had been developed under an appropriate quality system.

2.4(b) Safety Management Plan

R5. Recommendation 2.4(b)-1: The Regulatory Branch assessment recommends to the CEO that a condition of any licence to construct be that:

The licence holder must seek approval from the CEO prior to construction and commissioning of all systems, sub-systems, structures and components classified as Safety Category 1 and Safety Category 2, as identified in Chapter 2 of the PSAR.

R6. Recommendation 2.4(b)-2: The Regulatory Branch assessment recommends that training of all construction personnel and visitors to the construction site include basic safety and emergency awareness and this should be explicit in the Construction Emergency Plan.

2.4(c) Radiation Protection Plan

R7. Recommendation 2.4(c): The Regulatory Branch assessment recommends that any future revisions to the safety case or any application for a licence to operate address the following:

- (a) Radiation protection terms, particularly non-standard terms, should be clarified or removed from the safety analysis report and radiation protection plans;
- (b) Detailed rules and procedures relating to access control in forbidden and restricted areas.
- (c) More details of the potential noble gas fission product emissions from the reactor facility and their effect on any discharge authorisation.

Section 2.4(e) Security Plan

R8. Recommendation 2.4(e)-1: The Regulatory Branch assessment recommends that the detailed arrangements under the Construction Security Plan, for each phase of construction, must be submitted to ASNO sufficiently in advance to allow review and agreement prior to commencement of the phase.

R9. Recommendation 2.4(e)-2: If the CEO grants a Construction Licence, the Licence Holder must demonstrate to the CEO of ARPANSA that it has complied with the requirements of the Director General of the Australian Safeguards and Non-Proliferation Office (ASNO), being:

- (a) Bulk excavation must not commence until the Director General of the Australian Safeguards and Non-Proliferation Office has approved the Licence Holder's security arrangements for the bulk excavation phase of construction, and reported this to the CEO ARPANSA;
- (b) Construction activities related to any subsequent phase of construction must not commence until the Director General of the Australian Safeguards and Non-Proliferation Office has approved of the Licence Holder's security arrangements for that phase of construction, and this approval has been communicated to the CEO ARPANSA.

R10. Recommendation 2.4(e)-3: If the CEO grants a Construction Licence, the Licence Holder must ensure that the site security and threat assessments are:

- (a) formally reviewed by the national competent authority, Australian Security Intelligence Organisation, periodically on an ongoing basis and when circumstances change;
- (b) formally reviewed by the Australian Security Intelligence Organisation, updated and submitted with any application for an operating licence; and
- (c) the results of any such reviews are reported to the CEO of ARPANSA and Director General of the Australian Safeguards and Non-Proliferation Office.

R11. Recommendation 2.4(e)-4: Any submission seeking CEO approval for construction of an item important for safety under Regulation 54 or a licence authorising operation of the replacement reactor, should take into account the relevant recommendations in the separate security classified report on the Security Plan and in the Regulatory Assessment Report.

R12. Recommendation 2.4(e)-5: If the CEO grants a Construction Licence, the Licence Holder must ensure that the final design of hardware and software of computerised control, safety and security systems:

- (a) comply with any relevant Defence Signals Directorate security specifications;
- (b) have been independently reviewed by the Defence Signals Directorate, or some other appropriate expert acceptable to the CEO of ARPANSA, with regard to vulnerability to sabotage and hacking; and
- (c) are certified by Defence Signals Directorate for security compliance.

R13. Recommendation 2.4(e)-6: The matter of penetration of the concrete reactor building and reactor block by an engine of a large commercial aircraft and fire should be further analysed as work on this matter is undertaken throughout the world.

R14. Recommendation 2.5: If the CEO grants a Construction Licence, the Licence Holder must provide a design and commissioning plan that identifies and describes to the CEO's satisfaction:

- (a) the control points for items important for safety;
- (b) the process for gaining the required construction approval of the CEO for items important to safety; and
- (c) a schedule to implement the process consistent with the ARPANSA regulatory review process and response time.

3.1 *Defence in depth*

R15. Recommendation 3.1-1: In future revisions of the safety case or any application to the CEO for approval to construct a relevant item important for safety, the Applicant should demonstrate that:

- (a) isolating devices between the Reactor Control and Monitoring System and the Reactor Protection System and between the Reactor Control and Monitoring System and the Post Accident Monitoring System, comply with IEEE-384; and
- (b) sharing of sensors between the Post Accident Monitoring System and the Reactor Protection Systems does not jeopardise safety under design basis accident conditions.

R15. Recommendation 3.1-2: In the final safety case the Applicant should specify in the Operational Limits and Conditions a set of plant item Minimum Configurations for Operation, any permitted outages of one level of defence in depth or one level of redundancy within a defence in depth level.

3.2.2 *Safety analysis report*

R16. Recommendation 3.2.2: In any future revisions of the safety case the Applicant should update the PSAR as the detailed engineering progresses, with a frequency agreed with the CEO of ARPANSA, to reflect the 'as designed' and 'as built' status of the facility. The updates must take into account, to the CEO's satisfaction, any recommendations arising from this Regulatory Branch assessment.

3.2.3 *Categorisation by hazard and safety significance*

R17. Recommendation 3.2.3: In future revisions of the safety case the Licence Holder should:

- (a) Clearly state the hazard category of the facility.
- (b) Clarify the approach to modifications of safety category 1 and 2 items, in the quality assurance documentation, to confirm compliance with regulations 51 and 52.
- (c) Review the safety categorisations of structures, systems and components that carry out safety functions O and P in PSAR Table 2.5/1.

3.2.4 *Deterministic and probabilistic methodology*

R18. Recommendation 3.2.4-1: It is recommended that the Probabilistic Safety Analysis be revised, taking into consideration the findings outlined in the Regulatory Branch assessment, in the Final Safety Analysis Report presented with any application for a licence to operate the reactor. The revision should provide a mature 'living' analytical tool to support design, operational and accident management decisions and, in particular:

- (a) reflect the 'as built' design and include feed back,
- (b) address human factors in a systematic way including aspects associated with maintenance and all operational states,
- (c) estimate the consequences for individual events having frequencies down to about 10^{-7} per year,
- (d) include an analysis of the operator and off-site doses associated with the bounding accident sequences,

- (e) sum the event ranges as required in Table 2 of the Regulatory Assessment Principles to obtain the total frequency in a dose range.

R19. Recommendation 3.2.4-2: The Applicant should have the Probabilistic Safety Analysis independently peer reviewed and submit the peer review report with any application for a licence to operate the reactor.

3.2.5 Single failure analysis

R20. Recommendation 3.2.5-1: In revisions of the safety case related to regulation 54, the Applicant should:

- (a) update the failure modes and effects analyses for safety category 1 and undertake analyses for selected key active safety category 2 structures, systems and components; and
- (b) update the single failure analysis to reflect the detailed engineering of redundant items.

R21. Recommendation 3.2.5-2: In updating the final Probabilistic Safety Analysis to be submitted with any application for an operating licence, the numerical values used for the effect of single human failures should be updated to ensure that they are appropriate for operation of the as-built reactor.

3.2.6 Fire hazards

R22. Recommendation 3.2.6: A fire hazard assessment should be undertaken following finalisation of the detailed design of the replacement reactor, and include the effects of:

- (a) internal fires as design basis initiating events and any changes to their consequence estimates;
- (b) fires on the Reactor Control and Monitoring System and the possibility of a fire generating unsafe signals initiating withdraw control blades; the effect of fires and smoke on the FRPS, SRPS, FSS and the SSS, including any computer hardware based components;
- (c) fires on the coolant pumps; the effect of smoke and other generated gases on the safety of personnel in the reactor buildings including the containment, taking into account ventilation implications and building complexities.

The Safety Analysis Report and Probabilistic Safety Assessment should be updated to take account of the fire hazard assessment.

ARPANSA Regulatory Branch should consider using an independent fire hazard experts to review the fire hazard assessment.

3.2.9 Seismicity

R23. Recommendation 3.2.9-1: A number of SSC are classed as Seismic Category 2 that should be re-classed as Seismic Class 1. These are:

- (a) The Ventilation Discharge Stack (System 32 - sub-system 40)
- (b) The Auxiliary Building Structure (System 35 - sub-system 20)
- (c) Inter-connection Trench Reactor and Auxiliary Building

R24. Recommendation 3.2.9-2: Seismic-induced fire issues should be appropriately considered, an example being seismic-induced failure of a lube oil system (lube oil leaks on hot piping, and ignites).

R25. Recommendation 3.2.9-3: Seismic walk-downs should be performed at various stages during construction and upon completion. Such in-field evaluations are essential to identify potential failure modes from the seismic perspective.

R26. Recommendation 3.2.9-4: If the forces for the loading combination are generally less than about half of the ultimate strength for concrete and less than half yield for steel, the OBE (Stress Level 1) damping values should be used in the seismic analysis of the building, for developing the input motion to sub-systems or evaluating structural displacements. There should be confirmation that the 7% damping used for the Seismic Class 1 structures, systems and components is based on the assumption of high stress levels approaching the yield. If the stress levels are less than 50% yield at the Safe Shutdown Earthquake there should be an indication of whether 4% or 5% damping should be used.

3.3.2 Conservative design

R27. Recommendation 3.3.2-1: Any relevant application for approval of the CEO of ARPANSA for construction of an item important for safety, under Regulation 54, should include the following information:

- (a) details of the seismic qualification methods for key Safety Category 1 Structures, Systems and Components, including the control rod drives, for example by testing and/or analysis;
- (b) clarification of the extent to which nuclear standards such as ASME III and IEEE are to be applied in the detailed engineering of Safety Category 2 items, in particular exactly what parts of the IEEE Nuclear Standards for Power Generating Station will be used in the electrical systems;
- (c) an additional requirement for 100% inspection of all butt welds of Primary and Secondary Coolant Systems during construction;
- (d) use of IEEE 387 as a guide for the diesel generators, as practicable; and
- (e) further detail of the specific isolators that are to be used to interface the SPS with other electrical systems and what provisions are made for their performance testing.

R28. Recommendation 3.3.2-2: Because computer-based technology is used in the First Reactor Protection System and the Reactor Control and Monitoring System, the Regulatory Branch review recommends there be review by an independent specialist of their detailed engineering. That review should include a review of the potential for unintended cascading effects that might emanate from computer-based control of safety system settings, and age-related degradation of the computer-based equipment used in the systems.

R29. Recommendation 3.3.2-3: In any relevant application seeking CEO approval for construction of an item important for safety the Applicant should include:

- (a) Further information on the potential for age-related degradation of passive structural items that cannot be replaced, and further information on the potential for age-related degradation of the functional independence of safety systems and redundant trains within safety systems.
- (b) Details of the extent of the physical and functional independence of the redundancy in the Reactor Control and Monitoring System (RCMS).

- (c) Updated details of the construction and testing of the software in the Reactor Control and Monitoring System and the First Reactor Protection System, including details of ANSTO personnel involvement, and updated plans for training and maintaining competent personnel with adequate knowledge of the software during the operational life on the reactor.
- (d) Detailed engineering information for the First Reactor Protection System and RCMS in a form that is suitable for review by an independent specialist. That review should include a review of the potential for unintended cascading effects that might emanate from computer-based control of safety system settings, and age-related degradation of the computer-based equipment used in the First Reactor Protection System and the Reactor Control and Monitoring System.

R30. Recommendation 3.3.2-4: In the final safety case submitted with any application for an operating licence, the Applicant should identify structures, systems and components that are not amenable to inspection during normal shutdowns.

3.3.3 Physical security

R31. Recommendation 3.3.3-1: In a separate security classified report and in section 2.4(e) of this report, the Regulatory Branch review made a number of recommendations concerning:

- (a) ongoing monitoring of the security threat level by the competent Australian authority;
- (b) the specification, review and certification of computer based control systems by the competent Australian authority;
- (c) ongoing monitoring of the state of the art of physical protection and security systems, with a view to implementation in the constructed plant.

R32. Recommendation 3.3.3-2: In future revisions of the safety case the Applicant should:

- (a) Demonstrate that the level of redundancy provided in the on-site communication system is sufficient for all security situations.
- (b) Demonstrate that the design provisions which ensure that an unauthorised person cannot change the safety system settings in the First Reactor Protection System comply with the criteria for a safety system.
- (c) Include details of the restricted-access rooms for the engineering work-stations and the levels of access control for the Reactor Control and Monitoring System.
- (d) Demonstrate that there is appropriate access control of the alarm masking and inhibiting provisions in the Reactor Control and Monitoring System and that there is appropriate control of access to any process state signals that could influence the masking and/or inhibition of alarms.

R33. Recommendation 3.3.3-3: In the final safety case the Applicant should include details of the arrangements for controlling security access passwords for the Reactor Control and Monitoring System, the First and Second Reactor Protection System, and the security system.

3.3.4 Human factors

R34. Recommendation 3.3.4-1: In future revisions of the safety case, and in any submission seeking CEO approval to construct a relevant item important for safety under Regulation 54, the Applicant should:

- (a) Update the Probabilistic Safety Analysis and the calculated core damage frequencies to:
 - (i) adequately take into account human factors and the excluded human factor initiated fault sequences that were identified by the Regulatory Branch assessment,
 - (ii) include improved numerical estimates for modelling common cause failure in design, maintenance, and testing,
 - (iii) include the role of the operator under accident management and emergency response conditions at defence in depth levels 4 and 5, and
 - (iv) include cognitive factors such as:
 - level of understanding of the reactor under abnormal conditions;
 - errors of commission or omission with respect to procedures, such as those for the handling of fuel;
 - loading of irradiation rigs; and
 - Cold neutron source.
- (b) Demonstrate the stated commitment to review the ergonomic design at the detailed engineering stage against IEEE standards, and for a specialist Human Factors organisation to train ANSTO instrumentation and control staff in human factor aspects.
- (c) Include additional information describing monitoring and control operations that can be performed from outside the Main Control Room and Emergency Control Room, the location, and the extent of their potential impact on safety.
- (d) Clarify the “critical systems” for which the two independent backbone communication infrastructures will provide duplicate services.
- (e) Clarify the extent to which the communications systems are ‘dedicated’, and clarify whether the communications and CCTV (stated to be SC1) that is used as part of the PAMS (SC1) and emergency response, are part of the Communication System (SC2) or part of the PAMS (SC1).

R35. Recommendation 3.3.4-2: The Final Safety Analysis Report submitted with any application for an operating licence should:

- (a) Include specific details of the maintenance and inspection practices and access during the proposed two-day shutdown period for fuel handling operations and maintenance, and also details of the break-up of maintenance between shutdown and operation.
- (b) Identify and include in the Operational Limits and Conditions, a Minimum Plant Configuration for various operating modes to control outages of items important for safety in order to undertake repair, maintenance, testing and inspection.
- (c) Consider a more formal examination of procedures, instructions, training and work load of handling activities using “task analysis” and “HAZOP” methodologies.
- (d) Demonstrate the commitment to a manning analysis as stated in the responses to questions on PSAR chapter 13.
- (e) Include updated human factor and task analyses that are the basis for the development of procedures/instructions for the operation of the facility, including human interfaces with the Main Control Room and Emergency Control Centre.

3.3.5 *Quality assurance*

R36. Recommendation 3.3.5-1: If the CEO issues a construction licence, the Licence Holder must develop a procedure covering design modifications for compliance with regulation 51 and 52 and submit that procedure to the CEO for review. This procedure should assume the design of certain items important to safety has been approved under Reg 54.

R37. Recommendation 3.3.5-2: The Applicant should review its management and processes for internal review of the construction, and provide for an appropriately constituted Construction Safety Review Committee, so as to ensure the safety of the as-built facility, separate to any design review and verification function.

R38. Recommendation 3.3.5-3: Regarding the implementation of the Applicant's quality system:

- (a) The Regulatory Branch assessment recommends that the Applicant's contractors update their quality certification to the current standard (ISO 9000:2000).
- (b) The Regulatory Branch assessment recommends that as part of the quality system considerations, an explicit description of the design interfaces between the operator (ANSTO) and contractors (INVAP, JHEDI, Connell Wagner, etc) and the transfer of design skills and knowledge to eventual operators should be provided.
- (c) The Regulatory Branch assessment recommends that as part of the quality system considerations, the cold neutron source safety analysis needs to be integrated into any future revisions of the PSAR..
- (d) For any future application to operate, the CEO should require that secure, fire-protected storage and maintenance of the design records for the "as-built" facility will be in place.
- (e) The Regulatory Branch assessment recommends that as part of quality system considerations, the software of the FRPS and the RCMS should be independently reviewed, validated and verified by international experts agreed with the CEO.
- (f) The Regulatory Branch assessment recommends that as part of the quality system considerations, and to enable regulatory verification and audit under any construction licence, the project plans should:
 - more explicitly state ANSTO's required scope and level of contractor design reviews regarding verification; and
 - provide for transparent ANSTO design review and approval process.

3.3.6 *Radiation protection*

R39. Recommendation 3.3.6: The following recommendations should be addressed in any future revisions to the safety case or any application for an operating licence:

- (a) The current ANSTO Safety Directive (SD 5.4; note SD 3.4 has been superseded) needs to be incorporated and the information in PSAR section 12.3.1.1 on Derived Surface Contamination Limits and occupancy factors appropriately revised.
- (b) The rules and procedures to be observed for access to, work in, and exit from different areas including forbidden and restricted areas (see reactive review question 12.14) need to be provided.
- (c) Arrangements to replace the HEPA and charcoal air filters on the basis of in-situ testing with the decontamination factors set in any operating limits and conditions and testing done at an acceptable frequency (1 or 2 years).

- (d) Appropriate installed airborne radioactive contamination sampling and monitoring is provided, particularly under conditions when the containment is isolated and therefore there is no airborne monitoring using the stack discharge detectors.

3.4.2 Structural materials

R40. Recommendation 3.4.2: In future revisions of the safety case the Applicant should:

- (a) Justify the use of any brittle materials, such as cast iron, in the Primary Coolant Circuit and Reactor and Service Pool Cooling System, and the carbon steel components (valves, pumps) will not affect the safety of the reactor.
- (b) Provide information on quality control and verification of materials that may become activated at all levels including fasteners (nuts, bolts, washers etc)
- (c) Address the cathodic protection for dissimilar metal joints.

3.4.3 Design margins

R41. Recommendation 3.4.3-1: If the CEO decides to issue a licence to construct, the Licence Holder must make and implement a program of work, to be carried out during construction, validating computational modelling used to demonstrate the safe design of the replacement reactor and to support the safe operation of the reactor, to the satisfaction of the CEO of ARPANSA.

R42. Recommendation 3.4.3-2: With regard to the proposed program of work, to be carried out during construction, for further validating computational codes used to demonstrate the safe design of the replacement reactor and to support its safe operation for the specific core and fuel geometry:

- (a) The Regulatory Branch expects to be informed of, and agree to, the outcome at the 'decision points' identified in the program of work. In particular, ARPANSA expects to agree to identification of the gaps in validation and the program of work to address the gaps.
- (b) As part of the code validation program to be undertaken by ANSTO during construction, perhaps including in out of reactor experiments, ARPANSA will expect further validation of modelling of:
 - the generation of voids in coolant channels, and
 - the boiling, including pulse boiling, and flow redistribution correlations and that significant voiding during transients will not cause flow redistribution provided that the DNBR success criterion is satisfied for the particular fuel assembly geometry.
- (c) Results of the validation program must be presented in support for any application for a licence to operate the reactor.
- (d) The practicality and scope of direct thermal/hydraulic measurements using an instrumented fuel assembly during reactor commissioning, as recommended by the IAEA peer review, must be examined as part of any application for any operating licence.

R43. Recommendation 3.4.3-3: The Regulatory Branch recommends that, during construction, and as part of any related Regulation 54 submission:

- (a) the Licence Holder should examine implementing an automatic control method to prevent manual movement of control plates to positions other than those of predetermined control strategies;
- otherwise,
- (b) if cases where the peaking factor with adequate added margin exceeds three, analysis should be carried out for appropriate scenarios to demonstrate compliance with safety success criteria.

R44. Recommendation 3.4.3-4: The FSAR accompanying any application for an operating licence should include:

- (a) a statistical analysis of uncertainties using the manufacturing tolerances for the specific fuel to be used in the reactor, confirming the adequacy of margins for the power peaking factors,
- (b) demonstration of the power peaking factors for the initial cores leading up to equilibrium fuel cycles.
- (c) confirmation, using a 3-D transport code (such as MCNP), of the worst case power peaking factors calculated using CITVAP (3-D diffusion code).

R45. Recommendation 3.4.3-5: The Regulatory Branch assessment recommends that 100% inspection be conducted on all butt welds in the in the primary and secondary coolant systems, if the reactor should proceed to construction.

3.4.4 Core

R46. Recommendation 3.4.4: In any submission seeking approval of the CEO for construction of the relevant item important for safety, the Applicant should resolve the matter of safety category of all core components.

3.4.5 Heat transport systems

R47. Recommendation 3.4.5-1: In any submission seeking CEO approval for construction of a relevant item important for safety, the Applicant should provide additional information about:

- (a) The possibility of brittle failure of ferritic materials (possibly castings) to be used for some Primary Cooling System valve bodies.
- (b) The possibility of a failure of a pump flywheel causing pipe-work failure.

R48. Recommendation 3.4.5-2: In future revisions of the safety case the Applicant should:

- (a) Consider whether it may be more appropriate to trip the FSS rather than the SSS under conditions of high temperature or loss of flow in the RPCS, since the SSS dump may compound any overheating.
- (b) Demonstrate that during reflector dumping (as part of the SSS), there will be no overheating of the reflector vessel and its components, due to loss of RPCS flow and exposure of some components to a helium atmosphere.

3.4.6 Containment and confinement systems

R49. Recommendation 3.4.6-1: The Regulatory Branch assessment recommends that, for completeness, the detailed design of the containment should estimate the maximum internal pressure that the building could withstand and identify the limiting structural elements. Safety analysis report updates should contain information on loads to the building from high winds and missile, and on loads to the stack from high winds, missiles, and seismic events.

R50. Recommendation 3.4.6-2: Regulatory Branch recommends that the 2001 edition of AS-3735 be applied instead of the 1991 edition as proposed.

3.4.7 Shielding

R51. Recommendation 3.4.7: Any revisions of the safety case should describe in detail the complete sources of radiation, including for accident conditions, and the associated design of shielding, particularly for the main control room and air filters following DBAs.

3.4.8 Experimental devices and experiments

R52. Recommendation 3.4.8-1: In any safety case for the cold neutron source the Applicant should address:

- (a) the international peer review recommendations R12.1 and R12.2;
- (b) the justification for categorising the cold neutron source services as Safety Category 3; and
- (c) the storage of deuterium for the cold neutron source in the reactor building.

R53. Recommendation 3.4.8-2: Any revisions to the safety case should address:

- (a) experimental justification of the irradiation rig heat flux values to demonstrate that the design for onset of nucleate boiling is not exceeded for normal operations or anticipated operational occurrences; and
- (b) moisture penetration and nitric acid production in the nitrogen pneumatic gas lines for insertion of irradiation cans.

R54. Recommendation 3.4.8-3: Any final safety analysis report should include analyses of the simultaneous rapid insertion and removal of pneumatic rigs due to human or control system failure and the consequences of the associated reactivity insertions.

3.4.10 Nuclear material

R55. Recommendation 3.4.10-1: In any Final Safety Analysis Report submitted with any application for an operating licence information on the fuel 'ever-safe' time for fuel assemblies in air should be included.

R56. Recommendation 3.4.10-2: In any submission seeking approval of the CEO for construction of the Containment Energy Removal System, consideration should be given to providing radiation monitoring at all floor levels to warn of any build-up of air-borne radioactive contamination after the containment seals and the Containment Energy Removal System is operating.

3.4.11 Spurious operation and unsafe failure modes

R57. Recommendation 3.4.11: In future revisions of the safety case, the Licence Holder should evaluate the actual failure modes of the of SSCs at the 'hold point approval' (Reg 54) stage when the detailed design of all safety-related SSCs is known.

3.4.12 Static and dynamic loading

R58. Recommendation 3.4.12: In any application to the CEO seeking regulation 54 approval to construct a safety related item, the Applicant should address the following matters:

- (a) The reactor primary coolant and secondary coolant system pipe work should go beyond the AS 4041 inspection requirements and have, for example, 100% radiography of all butt welds.
- (b) In view of the large amount of energy they carry the material selection, pre-service inspection and in service inspection of the flywheels should be given special attention in any revisions to the PSAR.
- (c) The use of non-ductile valve or pump casings in the PCS or SCS should be re-considered.

3.4.13 Facility life management and decommissioning

R59. Recommendation 3.4.13: In the FSAR submitted with any application for a licence to operate, the Applicant should:

- (a) identify specific components that will be embedded in the concrete and any future properties, handling techniques and/or precautions that will need to be addressed or employed during dismantling and;
- (b) provide more detailed information on how to monitor the condition of the structures, systems and components that are difficult to inspect, repair and replace.

3.5 Defence in depth level 2

3.5.1 Domain of operational states

R60. Recommendation 3.5.1: In any application to obtain CEO approval to construct a safety-related item, and in future revisions of the safety case, the Applicant should:

- (a) Develop OL&Cs for specific items important for safety, during the manufacturing, procurement or assembly phases. This can be addressed at the Reg 54 approval stage; and
- (b) Give human factors additional attention during the Detailed Engineering Phase, FSAR, and PSA.

3.5.2 Inherent dynamic stability

R61. Recommendation 3.5.2: Any future revisions of the safety case should:

- (a) Confirm from the validated computational codes that the stability is not adversely affected by any changes in detailed engineering to core geometry, fuel type, fuel enrichment and, absorber type and burn-up.
- (b) Perform additional work in the code validation program to support the void coefficient values used in the analysis of the worst-case transients where some voiding of fuel channels occurs.

3.5.3 Process control systems

R61. Recommendation 3.5.3 The FSAR submitted with any application for an operating licence should address the following information for the finalised core design:

- (a) The burnable poison calculations should be independently checked; see section 3.4.3 and 3.4.4.
- (b) The possibility of shadowing of the neutron flux instrumentation by irradiation rigs.
- (c) Confirm that a single detector is used for monitoring power and that under manual control, movement of control blades is according to a predetermined strategy under administrative control.
- (d) ANSTO should show how the reactor control software application establishes operating modes and links to the associated Operational Limits and Conditions.

3.6 Defence in depth level 3

3.6.1.3 Human activity

R62. Recommendation 3.6.1.3: In the FSAR with any application for an operating licence, the Applicant should:

- (a) Ensure the full set of Operational Limits and Conditions and the administrative controls that are submitted with the FSAR, limit the quantities of toxic materials within the reactor building.
- (b) Confirm that control over the 1.6 km buffer zone will be maintained during construction and operation of the facility.

3.6.1.4 Fires and explosions

R63. Recommendation 3.6.1.4: In future revisions of the safety case the Applicant should:

- (a) Provide information addressing the effects of fire and of dynamic impact on the structural integrity of any windows in the containment structure;
- (b) Include vulnerability of safety category 3 cables, and temporary and foreign cabling, in the fire design and fire hazard analysis;
- (c) Address the reliability of pre-action sprinklers; and
- (d) Address the vulnerabilities of cable ducts D5 and D8.

3.6.1.5 Reactivity insertion

R63. Recommendation 3.6.1.5-1: Revisions to the accident analyses should reconsider worst situation rig movements amongst the additional scenarios for which bounding cases are to be analysed. The effectiveness of the second shutdown system to terminate such a transient should also be analysed.

R64. Recommendation 3.6.1.5-2: For completeness, revisions to the accident analysis should include analysis of any reactivity transient due to a cold slug caused by accidentally starting the third primary pump during various modes of operation. Consideration should be given to a valve isolation of the third pump rather than rely on an electrical interlock.

R65. Recommendation 3.6.1.5-3: During construction, and as part of any related Regulation 54 submission:

- (a) Consideration should be given to initiation of the power trip in the First and Second Reactor Protection Systems, during power ascension, based on margin above the operating power level rather than at a fixed level above full power.
- (b) Further validation of the models which include reactivity feedback due to the formation of voiding of the coolant channels, as part of the code validation program for the specific reactor geometry, recommended in section 3.4.3 above.

R66. Recommendation 3.6.1.5-4: The FSAR accompanying any application for an operating licence should include:

- (a) the full range of reactivity insertion analyses, in addition to the present bounding case analyses; and
- (b) a description of detector masking effects.

3.6.1.6 Unplanned criticality

R67. Recommendation 3.6.1.6: In the FSAR accompanying any application for an operating licence, the Applicant should:

- (a) Ensure criticality safety assessments included in the FSAR comply with criticality safety guidelines given in the ARPANSA report RB-ASR-53-00 and include the accidental analyses of all possible accidental events.
- (b) Arrange independent peer review of the criticality safety assessments of the fresh fuel and the spent fuel storage and handling systems be conducted and included in the FSAR. These reviews should address the need for criticality alarms in the controlled areas.
- (c) Provide criticality detection and monitoring devices in both the fresh fuel storage and the spent fuel storage areas, in line with international best practice in the nuclear industry.

3.6.1.7 Thermal, hydraulic and pressure systems

R68. Recommendation 3.6.1.7: In future revisions of the safety case the Licence Holder should:

- (a) Consider undetected blockage of a fuel assembly as a LOFA that involves fuel melting and use it for setting DBA environmental conditions for humans and SC-1 and SC-2 SSCs.
- (b) In the code validation program, take into account the results of experiments to demonstrate the effectiveness of the pulsed boiling mode of natural circulation cooling accident conditions.

3.6.1.8 Electrical supply

R69. Recommendation 3.6.1.8: In future revisions of the safety case the Applicant should:

- (a) Consider housing the two duty SPS diesels and their auxiliary systems in separate weatherproof rooms to provide ease of all weather maintenance, and to attain with

the Safety Category 1 status with respect to external loads such as earthquake and high wind.

- (b) Include a reliability analysis of the power supply system, including both the normal supply and the stand-by supply.
- (c) Undertake an independent third party audit of the detailed design arrangements for the power supply within six months of any construction licence, since the power supply is the only major item important to safety with a majority Australian industry design involvement. This should look in particular at how nuclear standards are implemented into the SPS design.

3.6.1.9 Ventilation, filtration and clean-up

R70. Recommendation 3.6.1.9: In any future revisions of the safety case the Applicant should:

- (a) Provide information on what happens to the heavy water ventilation system if the containment is sealed.
- (b) Include charcoal filters in the main control room emergency ventilation system
- (c) Provide decontamination factors for containment filters in the operational limits and conditions.
- (d) Estimate the consequences if the containment is venting through the stack filters in a BDBA (see section 3.6.2.11.5).

3.6.1.11 Experimental devices and experiments

R71. Recommendation 3.6.1.11: In future revisions of the safety case the Applicant should:

- (a) Provide information on international best practices used in the construction of zirconium alloy vessel for CNS in the CNS PSAR
- (b) Provide validation of the software used for the control of target movement including the information on the possibility of failure of the software.
- (c) Include standards used for the construction of hot cells.
- (d) Provide information on the operational limits and conditions of the hot cells.
- (e) Provide information on the decontamination factors for the filters used in the active ventilation system, which should be a part of operational limits and conditions.
- (f) Justify the heat flux value used for rigs and experiment.

3.6.1.12 Control rooms

R72. Recommendation 3.6.1.12: In any submission seeking CEO approval for construction of a relevant item important to safety, it is recommended that:

- (a) The viewing windows in the Main Control Room and Level +13m lobby should be reassessed in light of the recommendation 3.7.1-2 that the MCR remain habitable following a flow blockage to a full fuel assembly.
- (b) The expected status and effects of the shielding, ventilation and filtering in the case of fire in the control rooms should be described.

- (c) The full monitoring capabilities of the Post Accident Monitoring System should be provided to ascertain if it would be effective in monitoring for fuel damage during accidents. Also, consideration should be given to providing access the PAMS from the LHSTC Emergency Response Centre.
- (d) It should be indicated in the SAR whether the operation of the Containment Isolation System valves that are manually operated is by local or remote operation from the MCR or ECC.

3.6.1.13 Safety system settings

R73. Recommendation 3.6.1.13: In any future revisions of the safety case the Applicant should:

- (a) Confirm the inclusion of the period trip and coolant water outlet temperature trip in the SRPS, and consider having a variable margin flux level trip in the FRPS and SRPS.
- (b) Include in the OLCs updated numerical values for the safety system settings for all operational states.
- (c) Indicate the parts of the standard ISA-RP67.04 - Part II - 1994 that were used as guidance in establishing the numerical values for the safety system settings.
- (d) Update the description of the design provisions to protect against safety system settings being inadvertently changed or altered by unauthorised personnel to include the SRPS.
- (e) Include details of the administrative procedures for authorising the accessing and changing of all safety system settings.

3.6.2.1 Classification and identification of safety systems

R74. Recommendation 3.6.2.1: In future revisions of the safety case the Applicant should:

- (a) Resolve the matter of safety category of Safety Function P items. This could mean that the compressed air systems for the FSS and SSS would be SC1.
- (b) Include updated information on the qualification of SC2 SSCs.
- (c) Ensure that as the detailed engineering progresses, design drawings show that when constructed, safety systems (defence in depth level 3) will be distinguished by clear markings (for example, colour codes or fixed notices) so that they all stand out in contrast to systems that are used for safety at other defence in depth levels.

3.6.2.2 Fault tolerant, balanced design

R75. Recommendation 3.6.2.2: In future revisions of the safety case the Applicant should, in the process of finalising the design basis accident analyses, take into account the following postulated initiating events:

- (a) Complete flow blockage of a fuel assembly, for the purposes of qualification of the main control room habitability and some safety systems within the containment.

- (b) Reactivity, or other transients, possibly due to a human error in fuel loading, for the case of worst possible core configuration.

3.6.2.3 Redundancy, independence and diversity

R76. Recommendation 3.6.2.3: With regard to redundancy, independence and diversity, in future revisions of the safety case the Applicant should:

- (a) Clarify how the unavailability of the RCMS will be determined for the purpose of generating a trip parameter for the FRPS.
- (b) Review the close proximity of the cable routes through D5 to D8 by demonstrating compliance with IEEE 384 and taking into account the potential vulnerability of the ducts.
- (c) Provide more detail regarding the use of human diversity for the design of redundant, diverse safety systems, particularly in relation to validation and verification of design codes and software for computer-based items that are important to safety.
- (d) Include information demonstrating the effectiveness of the shutdown systems (that the reactor can be shutdown safely for all PIEs assuming only gravity drop of four out of five of the control rods).
- (e) Consider the inclusion of the temperature of the primary coolant at the core outlet as a parameter covered by PAMS.
- (f) Include in revisions of the PSA the power supply reliability for a chosen mission time (say 24 hours).
- (g) Include in revisions of the PSA, the results of an evaluation of the reliability and performance of the containment.
- (h) Include in revisions of the PSA, the results of an evaluation of the reliability and performance of the CERS in maintaining the containment below its design pressure.
- (i) Reconsider the structural, pressure and shielding limitations associated with the control room and public viewing windows for the containment design.
- (j) Identify all SC2 SSCs that have undergone a FMEA or single failure analysis.

3.6.2.5 Measurement of process variables

R77. Recommendation 3.6.2.5: The full monitoring capabilities of the PAMS to aid effective accident management measures will be required in any revisions of the Safety Analysis Report. This should include pool bulk water temperature and airborne radioactivity levels in the containment.

3.6.2.6 Initiation

R78. Recommendation 3.6.2.6: Any revisions of the Probabilistic Safety Analysis will need to further address human factors, and the role of the operator under accident management and emergency response at defence in depth levels 4 and 5.

3.6.2.7 *Disabling/bypassing*

R79. Recommendation 3.6.2.7: Any revisions to the Safety Analysis Report and the Probabilistic Safety Analysis will need to take into account outages or unavailability from disabling or bypassing safety functions during all operating modes of the replacement research reactor.

3.6.2.8 *Protection system*

R78. Recommendations 3.6.2.8: In any future revisions of the safety case the Applicant should:

- (a) Make the failure of a single control rod, rather than failure of two, to drop on a trip demand, the First Shutdown System failure criterion for triggering the Second Reactor Protection System and Second Shutdown System.
- (b) Ensure that the Safety Function P structures, systems and components that are required for the First Reactor Protection System and the Second Reactor Protection System have the same safety category as those protection systems.

3.6.2.9 *Shutdown systems*

R79. Recommendation 3.6.2.9-1: The FSAR should establish the required status of the Second Shutdown System during maintenance of the Reactor Control and Monitoring System and provide assurances that only one control mechanism would be maintained at a time if fuel is loaded in the core..

R80. Recommendation 3.6.2.9-2: Any regulation 54 submission seeking CEO approval for the construction of the Reactor Control and Monitoring System, should include a failure modes and effects analysis of the final design of the Reactor Control and Monitoring System with respect to reactivity insertion accidents.

R81. Recommendation 3.6.2.9-3: Further validation of the modelling of negative reactivity feedback associated with the formation of voids in coolant channels, as part of the computational code validation program, as discussed in Sections 3.4.3 and 3.6.1.5.

R82. Recommendation 3.6.2.9-4: Any regulation 54 submission for the construction of the FRPS/FSS, SRPS/SSS or RCMS should include:

- (a) revised event trees and fault trees for the detailed engineering design of the FRPS and SRPS, and the results should be included in revisions of the SAR and final PSA;
- (b) an examination of the use of mechanical locks to prevent simultaneous maintenance of more than one control rod when the control rods are unlatched from the drive mechanisms during maintenance; and
- (c) a demonstration of the adequacy of the tolerances associated with the control blades and demonstration that their operability would not be impaired by the introduction of foreign material during operation or maintenance.

3.6.2.10 *Testing, inspection, and maintenance*

R83. Recommendation 3.6.2.10: In future revisions of the safety case, the Applicant should:

- (a) Make available to the CEO for Regulation 54 purposes, the detailed testing, inspection and maintenance activities for safety systems. That information would form part of the revisions of the PSAR.
- (b) Ensure that factory testing of the protection systems demonstrates that the protection systems can be interconnected (via qualified isolators) without adverse effects and that the interconnected system is fully tested. The interconnection should be appropriately qualified for nuclear applications.
- (c) Ensure that the performance of the SSS is tested while in service, other than to check the opening of the drain valves with the drainage isolated. The SSS operation should be checked every shutdown, and periodically the reactor should be actually shutdown from power using the SSS rather than the controlled insertion of control rods.
- (d) Ensure that performance testing is conducted of the natural circulation provisions. Testing of natural circulation depends on the reactor having fuel loaded. The siphon effect breakers and the EMWS (emergency make-up water system) should be proven during 'cold commissioning' and during major reactor shutdowns when the reactor fuel is unloaded.
- (e) Test the capability of the Containment Energy Removal System (CERS) with and without the containment isolated. This should be clarified during the Regulation 54 approval process. Furthermore, a periodic test should be planned and performed to establish the capability of the CERS during a normal reactor shutdown.
- (f) Factor the maintenance, inspection and testing activities into the safety system availability numbers used in the Probabilistic Safety Analysis (PSA), to demonstrate that safety limits are met for the range of design-basis accidents (DBAs) and beyond-design-basis accidents (BDBAs) considered in the PSA.
- (g) Establish the leak tightness of the core chimney and the control rod drive room during pre-commissioning tests and periodically during major shutdowns when fuel is removed from the core. Technical details of pre-commissioning tests should be made available during the Regulation 54 approval process for specific items.
- (h) Test the control rod guides, fuel assembly and beam tube penetration seals during pre-commissioning tests to demonstrate the robustness of the design to LOCAs.

3.6.2.11.2 Residual heat removal system and ultimate heat sink

R84. Recommendation 3.6.2.11.2-1: The Regulatory Branch assessment considers that the three-way valve that defines which lines are connected to the pumping equipment of the Long Term Pool Cooling system should be re-evaluated to determine if there is a simpler valving arrangement to separate it from the RSPCS functions during operation.

R85. Recommendation 3.6.2.11.2-2: The Regulatory Branch assessment considers that the performance of the primary coolant pumps and the Long Term Pool Cooling System pumps should be established for higher pool temperatures associated with restarting following prolonged natural convection cooling of the core decay heat without heat removal from the pool.

3.6.2.11.4 Space conditioning system

R86. Recommendation 3.6.2.11.4-1: It is recommended that the Emergency Control Room be designed to be habitable during the siting reference accident and its intake air includes a dedicated activated charcoal filters in addition to the HEPA filters already provided.

3.6.2.11.5 Containment systems

R87. Recommendation 3.6.2.11.5-1: As part of a Regulation 54 approval process, the Safety Analysis Report should be updated to provide demonstration that containment and accident management systems are environmentally qualified for, and would remain operable during, a siting reference accident.

R88. Recommendation 3.6.2.11.5-2: The Regulatory Branch assessment expects an evaluation of the effect of static water head from spillage from tanks and fire fighting water on the containment structure to be included in the detailed engineering design.

3.6.2.11.6 Containment isolation system

R89. Recommendation 3.6.2.11.6: Any submission requesting CEO approval for the construction of the relevant systems, under Regulation 54, should re-consider the valving arrangement inside the containment and the need for a second pipe vent penetrating the containment boundary for both the containment pressure and vacuum relief systems to the stack.

3.6.2.11.7 Containment energy management system

R90. Recommendation 3.6.2.11.7-1: Detailed engineering of the CERS should provide an alternative to the heat exchanger common to the two CERS trains, in order to avoid compromising independence of the trains. This should be addressed as part of any relevant Reg 54 submissions to gain CEO approval prior to construction of the item.

R91. Recommendation 3.6.2.11.7-2: Implications for accident recovery of spreading radioactive contamination by recirculating containment air during an accident should be examined in any updated of the Safety Analysis Report. The implications for fires should be examined as part of the fire hazard analysis.

3.7 Defence in depth level 4

3.7.1 Beyond-design-basis accidents

R92. Recommendation 3.7.1-1: Revisions to the accident analysis presented in the safety case should include best estimate consequence analysis for beyond design basis accidents having frequency estimates down to 10^{-7} per year, in the FSAR submitted with any application for a licence the reactor.

R93. Recommendation 3.7.1-2: As part of any further submissions made by the Applicant under regulation 54, the Safety Analysis Report should be updated to provide demonstration that the Main Control Centre would remain habitable and defence in depth level 3 safety systems would remain operable following fuel damage resulting from a loss of flow to a full fuel assembly at power.

R94. Recommendation 3.7.1-3: Revisions to the safety case, and any submissions to construct the relevant safety items under regulation 54, should address:

- (a) undetected full flow blockage to a single fuel assembly as a design basis accident;
- (b) effectiveness of SSS following the BDBA of primary pump seizure and failure of FSS; and
- (c) fuel bypass flow.

R95. Recommendation 3.7.1-4: Any regulation 54 submission containing the detailed design of the control rod room should fully address the consequences of leakage associated with failure of control rod and fuel assembly penetrations.

R96. Recommendation 3.7.1-5: Revisions to the PSAR should include the effect of large pipe size breaks amongst the additional accident scenarios for which bounding cases are to be analysed.

3.7.2 Accident management

R97. Recommendation 3.7.2-1: Any regulation 54 submission to construct the Post Accident Monitoring System should make provision to:

- (a) monitor the reactor pool water temperature; for example, at locations at the top of the chimney and well outside the chimney;
- (b) address the environmental qualification of the PAMs for accident conditions;
- (c) address the extent of gamma monitoring of the containment atmosphere following containment isolation; and
- (d) address the environmental qualification of the primary and long-term pool cooling system pumps to operate after prolonged natural circulation and heating of the pool water.

R98. Recommendation 3.7.2-2: Any revisions to the safety analysis of the performance of the Emergency Make-Up Water System should consider the possibility of the float valves operating on chimney water level rather than on pool water level. The leak tightness of the reactor chimney structure should be demonstrated during commissioning and periodically throughout the life of the plant.

R99. Recommendation 3.7.2-3: Any revisions to the accident analysis presented in the safety case should include additional evidence, possibly including out of reactor tests, to further substantiate the 'pulse boiling' mode of cooling, for the specific replacement reactor fuel element geometry. This work should be part of the code validation program.

R100. Recommendation 3.7: For any future revisions of the safety analysis, the design of accident management provisions should consider the effect of the implementation of the recommended revisions to the safety analysis described elsewhere in this report (eg in section 3.7.1 above in relation to BDBAs). These considerations should include the environmental qualification (eg radiation, temperature resistance) of safety systems important for accident management and the habitability of the main control room under the revised scope of design basis accidents (such as complete fuel assembly melting under water).

3.8 Defence in depth level 5

3.8.1 Siting

R101. Recommendation 3.8.1-1: The Regulatory Branch assessment recommends information on any identified special needs groups be provided in revisions to the safety case and also be explicitly identified in the emergency planning arrangements.

R102. Recommendation 3.8.1-2: The Applicant should ensure that future revisions to the safety case describe the methods and outcomes of regular, systematic reviews of changes and new developments regarding nearby facilities and land usage in the vicinity of the reactor.

R103. Recommendation 3.8.1-3: The ANSTO Waste Operations licence holder must seek the CEO's prior approval to make proposed change to upgrade the existing waste water infrastructure at LHSTC. This should include a description and analysis of radiological pathways to workers, members of the public and the environment. The impact of increased water consumption due to the proposed replacement reactor. The impact on the replacement reactor (and other facility licences held by ANSTO) needs to be described in detail in revisions to the relevant safety cases.

R104. Recommendation 3.8.1-4: The construction phase emergency procedures must be available to the CEO for review and audit within three weeks of the date of any licence to construct. These procedures should demonstrate to the CEO's satisfaction the arrangements for emergency response affecting the construction site workforce for any incident, including radiological incidents, on the LHSTC site.

R105. Recommendation 3.8.1-5: The following matters related to emergency arrangements in the safety case should be addressed in any application for a licence to operate the facility.

- (a) The description of the emergency arrangements should be self standing and not rely on referencing out to chapters of the PSAR which cover design and operational issues. For example PSAR chapter 20 needs to address matters from 10.2.19 on fire emergency planning and training. Also figures 20.2/1 to 20.2/8 need to justify the location of escape routes against the radiation protection requirements as indicated in PSAR 12.6.2.
- (b) More details should be provided on the three emergency zones; for example, rather than just identifying the distances, there should be a basis of what happens in these zones such as automatic countermeasure, pre-planned countermeasure, or countermeasure based on measurements.
- (c) More details should be provided on the emergency sign posting, lighting and communications within the reactor facility.

3.8.2 Off-site emergency response

R106. Recommendation 3.8-6: In any future application for a licence to operate, the Applicant should present emergency planning arrangements having the capability to implement off-site responses, comparable to the existing arrangements for HIFAR.

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