Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
11.1	11.3 Brief description of facilities	Positions of BIF, LRT, SRT and LVF are very difficult, if possible, to find on provided Figures.	It is not easy to figure our where different irradiation positions are located. 1) From Figures 11.4/2 one can see BIF. It is said on page 11.3-1 that there are 17 BIF position. Contrary to that statement one can see more positions on the 'Zoom View' of the Figure 11.4/2. 2) As Figure 11.4/6-2 differs from Figure 11.4/2, it is difficult to figure out where LRT are located. LRT are not clearly shown on Figure 11.4/2. 3) Silicon irradiation facilities are clearly shown on Figure 11.4/9. However, on page 11.3-2, these positions are called 'LVF'. Why then they are not shown as LVF on Figure 11.3-2? 4) Readers can only guess where are SRT on the above Figures? 5) It is strongly recommended to show all BIF, LRT, SRT and LVF on one Figure, say Figure 11.4/2. Appropriate references to this Figure should also be given in Section 11.3 while discussing this or that irradiation facility.
			Response: 1) The 'Zoom View' of Figure 11.4/2 shows the 17 BIF positions as follows: i) 12 Medium Flux BIF facilities marked 'M' ii) 3 High Flux BIF facilities marked 'H' iii) 2 Very High Flux BIF facilities marked 'VH' 2) The coordinates of LRT positions are given in Figure 11.4/6-1 and their locations 1 to 17 are marked on Figure 11.4/6-2. Although not identified, Figure 11.4/2 shows all LRT positions. 3) Figure 11.3-2 referenced in ARPANSA comment should be corrected to read as Figure 11.4/9. We agree that the title of Figure 11.4/9 should identify the facilities as LVF. This will be amended in the next revision of the PSAR. 4) The position of SRT is shown on Figure 11.4/6-2 as NAA/DNA Irrad. Tube. 5) Although not identified, Figure 11.4/2 shows all irradiation facilities.
11.2	11.3.1 Bulk production irradiation	2^{nd} para - 'Targets are --'	Should it be irradiated targets?

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
	facilities		
			Response: The preceding sentence and the latter part of this sentence identify them as 'irradiated targets'.
11.3	11.3.2 Long residence time general purpose irradiation facilities	2nd para - 'The pneumatic --- for cooling--'	It is not clear what type of cooling is carried out. Clear statement or reference to relevant section is needed.
			Response: Section 11.3.2 is intended to provide a brief description and further details are given in Section 11.4.2.1.2. The pneumatic system provides both cooling and transfer of targets to and from irradiation positions.
11.4	11.3.4 Large volume irradiation facilities	3rd para - 'the silicon ingots or samples are rotated ---'	Is there any numerical value on rotation? (number of rotation per unit time)
			Response: Testing of the prototype rig has been performed at 10 RPM. The irradiation quality is not dependent on speed of rotation and as such it will be maintained as slow as possible. Further information will be provided in the FSAR.
11.5	11.3.5 Hot cells and auxiliary facilities	4th para - 'one transfer hot cell --- two pneumatic hot cells--'	What is the activity limits (operational limits) for these cells?
			Response: Section 11.4.5.1 states that information relating to shielding is given in Chapter 12, Section 12.3.2. Section 11.4.5.3 states that pneumatic hot cell shielding is designed to support a target activity equivalent to 100 GBq of Na-24 plus 10 cans unloaded sequentially over a 30 minute period.
11.6	11.3.6 Neutron beams	Last para - 'shutters -- safety interlocks'	Are they failsafe?

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			Are there any engineering Standards for these interlocks?
			Response: Yes, they are failsafe in that they do not move on power failure. They can be closed manually (see Chapter 16, Section 16.15.7.3) There are no engineering standards related to interlocks.
11.7	11.3.6 Neutron beams	Uncertainty of dose calculations	What is the uncertainty of calculated 20 µSv/h dose? Was that uncertainty included in 20 µsv/h dose?
			Response: The preliminary calculation is 6 µSv/h using the 2-D model. The design aim is 10 µSv/h. The contract specification is 20 µSv/h. Using a design target lower than specification ensures that the calculated value plus the uncertainties in the calculations shall be lower than this 20 µSv/h. In Detail Engineering stage, 3D calculations are being performed to obtain a more accurate dose rate considering possible uncertainties.
11.8	11.3.7 Cold neutron source	4th para - 'Consistent with international practices---'	This para needs to be more clearly stated. What international practices? Give example.
			Response: The CNS zirconium alloy vessel is designed to pressure vessel standards to withstand a hypothetical Deuterium – Oxygen explosion. International examples are shown in the following table The Table at Attachment 11.1 will be added at the end of Chapter 11 in the next revision of the PSAR.
11.9	11.3.7 Cold neutron source	Figure.	A reference to an appropriate figure (eg. Figure 11.5/16) should be provided in this section.
			Response: Section 11.3.7 is intended to provide a brief description. Further details are given in Section 11.5.3.
11.10	11.3.7 Cold neutron source	Reliability	Is it a proven technology? If 'yes', where has similar design been used?
			Response: Yes, it is a proven technology. There are more than a dozen CNSs in various

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			reactors in different countries that utilise liquid deuterium or hydrogen. The expertise obtained in these facilities has generated a significant amount of available information on successful operation, on which the RRR CNS design is based. Please, see attachment 11.1.
11.11	11.3.8 Hot neutron source	Future plans to install the hot neutron source	How would SSS efficiency be decreased (through decrease of reflector efficiency) by the hot neutron source installation? Did you take into consideration the above in the current design of the reflector? Do you expect to fill the currently empty tank (reserved for the hot neutron source) with the heavy water?
			Response: The HNS is not part of the RRRP. Provisions have been made for the possible future addition of a HNS. A separate Safety Analysis Report will be submitted to ARPANSA for approval prior to any HNS installation. Yes, the position reserved for the HNS will be filled with heavy water.
11.12	11.4 Irradiation facilities	Handling of rigs:	Is there any estimation of frequency of accidental dropping of items?
			Response: The PSA has identified this as an event with very low likelihood. Accidental dropping will be minimised by the provision of appropriate operator training and specific tooling provisions. Protective measures against this event have been taken independently from the frequency of occurrences (mesh over chimney, covers in reflector tank, layout of pool internals components, etc).
11.13	11.4 Irradiation facilities	Maintenance and decontamination: (d) 'in-line-filters'	It is not clear what filters are in-line filters?
			Response: These are absolute filters installed in the Nitrogen cooling gas return line.
11.14	11.4 Irradiation facilities	Terminology	Both 'core' and 'pile' terminology has been used on page 11.4-2 in one sentence. As psar uses 'core' terminology everywhere, it is misleading to use 'in-pile' terminology instead of 'core'.

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			Response: Accept change to "in-core". This will be amended in the next revision of the PSAR.
11.15	11.4 Irradiation facilities	'Sufficient perturbation [of neutron flux reading] could occur only in the case of removal of a silicon ingot and its replacement with the equivalent large volume of water'	Is it anticipated operational occurrence or abnormal event? If it is anticipated operational occurrence, what is an expected frequency of such event?
			Response: Even though this effect will occur, the layout of the nucleonic instrumentation and silicon facilities has been specially optimised to minimise the effect, see Figure 11.4/9 The arrangement in the nucleonic instrumentation guarantees that this will not affect in the same degree all the measuring channels at the same time. Based on figures available two years ago the expected silicon production would have been approximately four times greater then HIFAR's current production. Recent industry trends however are showing that perhaps only high resistivity silicon may be irradiated by the time the RRRP becomes operational, therefore it is not possible at the present time to predict daily usage.
11.16	11.4.1.1 Description	2^{nd} para - (a) '-- production of Mo-99'	Is this for both fission Mo-99 and (n,γ) Mo-99?
			Response: This refers to fission Mo-99. Other isotopes of interest could be produced in these rigs by (n,gamma) and similar reactions, from time to time, including Mo99 if desired.
11.17	11.4.1.1 Description	'The design allows more than three rig movements per day'	Please clarify how many rig movements per day are expected. Does the design limit the number of rig movements per day?

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			Response: The contract states that the design shall ensure that a minimum number of 3 rigs can be unloaded per day, however it is expected that 5, or more may be unloaded on a daily basis. The only limits applicable to rig movements are operational time limits and other movements of targets such as silicon loading and unloading.
11.18	11.4.1.1 Description	Maximum rig power and total rig power	Is it a requirement (design criteria) or actual (expected) powers?
			Response: This is a design criterion.
11.19	11.4.1.1 Description	'The irradiation tubes are provided with a replaceable nozzle at the bottom that permits individual adjustment of the coolant in each tube'.	Why is such adjustment needed?
			Response: To balance water flows between rig tubes if needed.
11.20	11.4.1.1 Description	Thermal neutron flux calculations for each rig position.	What is meant by 'averaged over number of irradiated tubes' and 'averaged within any target position'? In (a) it is said that 'thermal flux bill be less than $1.5x10^{14}$ $c.cm^{-2}s^{-1}$' while in (b) and (c) it is said that 'thermal flux bill be not less than …'. Is it a misprint or there is some logic behind the above difference in wording? It is said in (c) that 'removal and replacement of a rig at power will be permitted only if…'. Is it relevant for (c) only? It should be relevant for (a-c) and, therefore, it should be clearly written in a separate para.
			Response: As an example for (a), the minimum flux of $8x10^{13}$ $n/cm^2/s$ is the average over the total of 12 medium flux facilities primarily designated for the production of Mo-99. The minimum flux of $6x10^{13}$ $n/cm^2/s$ is the average within any individual target position in any rig. The maximum flux of $1.5x10^{14}$ $n/cm^2/s$ quoted in (a) is not a misprint. This is the upper level

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			of flux requested for medium flux facilities to maintain heat flux within limits. The radioisotopes intended for production in these facilities are specified on page 11.4-2. It is unlikely that the reactivity worth of rigs containing Mo 99 and Tellurium targets would exceed the specified limit of 200 pcm. The limit applies to all rigs but would be of significance only for Iridium rigs designated to be irradiated in Very High Flux facilities.
11.21	11.4.1.3 Safety Design Provisions	b)Rig movements: 'The rig cooling -- at full power'	This statement does not read well. Are there any limits on rig movement?
			Response: This means that only a slight perturbation in cooling flow to remaining rigs occur when one rig is extracted. The limits applicable for rig movements will be provided in the FSAR.
11.22	11.4.1.3 Safety Design Provisions	k) Target cladding failure/leakage: 'The fission product detector--'	What type of fission product detector is this one?
			Response: The working principle of this detector is based on detection of delayed neutrons. Cladding failures lead to release of fission products such as ^{87}Br and ^{137}I. These isotopes are in the water and generate neutrons that can be thermalised. The monitor uses a BF_3 neutron counter to detect the presence of thermal neutrons coming from fission products and reports their detection.
11.23	11.4.1.3 Safety Design Provisions	a) Rig cooling	Please provide a basis for choosing the limit on a rig heat flux (30% below ONB heat flux). What is total calculation error of a rig heat flux? Please provide a basis for the error estimation.
			Response: The 30% margin is chosen to be sufficiently high to ensure the absence of nucleate boiling. Since nucleate boiling by itself does not constitute a critical phenomenon (but is a necessary precursor to, and has considerable margin from the phenomenon of critical heat flux), the 30% margin is an additional assurance of adequate margin to this phenomenon. The above margins are conservative as they are based on the maximum design power. The maximum heat fluxes considered have no uncertainty as they are specified in the

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			tender document. The requirement is that the heat be safely and adequately removed for these maximum specified heat fluxes.
11.24	11.4.2.1 Description	Neutron fluxes	Figure 11.4/6-1 is a Table rather than Figure. It should include total uncertainties of neutron fluxes rather than showing '~', '<' or '>', which is misleading. What is meant by 'uniformity of fluxes between target positions at a given flux level'? What is meant by 'flux perturbation level'? Do you refer to both thermal and fast fluxes while talking about uniformity and perturbation? Did you take into account uncertainties of neutron fluxes talking about the limit: '30% below ONB heat flux'? Refer to Q.11.4.1.3. It is not a trivial task to calculate neutron fluxes in numerous different rig positions due to a large size of reflector and, strictly speaking, lack of cylindrical symmetry. Please explain your calculation methodology used for estimation of neutron fluxes. What is your methodology error in neutron flux calculations in a view of the above comment? Please provide a basis for the methodology error estimation.
			Response: The values presented in Figure 11.4/6-1 are contractual requirements for the respective flux levels. More precise values are given in Chapter 5, Table 5.7/5. The uncertainties in the latter flux estimates are 10%. For each flux level there are several target positions. The variation in flux for the targets within a given flux level is less than ±10% of the relevant flux level. The loading and unloading of a target within a given facility leads to flux perturbations for other targets positions both within the same facility and for other facilities. These perturbations are less than 5% for the relevant flux level (thermal flux for thermal flux facilities and fast flux for the fast flux facilities). As given in the response to Question 11.23, the ONB margin of 30% applies for the design power. As the calculated peaking factor for BOC and EOC is 2.0 (Table 5.7/2), the assumed value of 3.0 in effect incorporates uncertainties in neutron fluxes. Details of the codes used to calculate fluxes within the irradiation facilities are presented in Chapter 5, Section 5.10. In summary, a 3-dimensional multi-group diffusion code based

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			on CITATION-II is used to estimate fluxes within the irradiation facilities. Cross sections are calculated using the code CONDOR based on the collision probability method in a multi-group scheme.
11.25	11.4.2.1 Description	Neutron flux perturbation due to cadmium use	What is meant by 'neutron flux'? Is it thermal, fast or total flux?
			Response: The "neutron flux" – refers to thermal flux for a thermal facility and fast flux for the fast facilities. The use of Cadmium refers only to fast flux facilities. The perturbation refers to change in thermal flux in thermal facilities and to changes in fast flux in fast flux facilities.
11.26	11.4.2.1.1 Target triggering system	5th para – ' medium pressure tank – high pressure tank'	Need to be specific using numerical values.
			Response: The final values (to be defined in Detail Engineering stage) will be provided in the FSAR. Present values are: 120, 500 and 800 kPa for low, medium and high-pressure tanks.
11.27	11.4.2.1.2 Target cooling circuit	11th para - 'Absolute filters--'	Explain. Are they HEPA filters?
			Response: These are filter elements of similar performance to HVAC type HEPA filters with housing appropriate for installation in compressed gas lines.
11.28	11.4.2.2 Normal operation	11th para - 'The software--'	Is the validation of the software done?
			Response: Software design and validation will be part of the Detail Engineering Phase.
11.29	11.4.2.2 Normal operation	Loading and unloading operations for the 55 irradiation positions	One terminal station is serving 15 irradiation positions. Does it mean that 15 rigs may accidentally be withdrawn?

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			Response: Under normal operation, the software design would allow only one target movement at a time from any irradiation position. Built-in interlocks prevent the accidental removal of more than one rig.
11.30	11.4.2.3 Safety design provisions	1st para - 'LRT -- '. 'inherently safety design features --'	Is there any Standard for design of LRT? If so please refer to that Standard. Explain the inherent safety features.
			Response: No design standard is known to exist for this type of equipment. The safety features are listed in the same PSAR section related with the potential incidents (bulleted from a to j)
11.31	11.4.2.3 Safety design provisions	b) Target activity : 'equivalent to 100 GBq of Na-24'	Is there any special reason for considering Na-24 as reference?
			Response: It is an isotope of moderate half-life with highly penetrating radiations that is activated with reasonable frequency in current irradiations. It is a reasonable basis for the definition of a maximum target activity.
11.32	11.4.2.3 Safety design provisions	d) Can stuck in transit: 'the radiation dose ---'	Is there any estimation of the dose to the operating personnel during recovery operation?
			Response: Doses are a function of sample content (half-life, emissions and energies), irradiation parameter and place where the can remains stuck. As in every planned operation the dose will be kept as low as possible taking advantage of: 1. Plans to recover the can would need prior approval as required by the normal safety/ review procedures in force at the time. 2. The operation will be performed after a certain time to allow for aluminium decay. 3. The operation will be performed while other samples are prevented from being transferred. Nevertheless, during detail engineering, shields are being designed and located to allow

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			access to areas so that recovery actions can be performed without personnel exposure to the stuck can.
11.33	11.4.2.3 Safety design provisions	e) Target mishandling: 'which are software based-"	Is the software validated?
			Response: Software design and validation will be part of the Detail Engineering Phase and will be addressed in the FSAR.
11.34	11.4.2.3 Safety design provisions	a) Target power: If the temperature reaches a set limit, the system will automatically remove the can from its irradiation position	Does it mean that if the reactor will go accidentally critical and its power will increase with the following quick increase rigs power, all overpowered rigs will be automatically withdrawn by the pneumatic system adding positive reactivity to already supercritical reactor?
			Response: This manoeuvre is intended to prevent can damage by excessive power in a single target (for example due to a too large target mass), or a reduction in cooling (for example, due to a problem in the gas lines). In the case described in the comment, the reactivity contribution produced by can removal (given in Chapter 5, Table 5.7/15) is negligible compared with the negative insertion associated with the FSS and/or SSS activation. In case there is a peak in the reactor power, and the power rises above the settings of the FSS, the reactor will be promptly shutdown and there is no need for fast recovery of the targets.
11.35	11.4.2.3 Safety design provisions	f) Loss of cooling: In the event of a loss of cooling … several signals feeding the RCMS will initiate a reactor power reduction, in order to	What is meant by 'power reduction'? How long the reactor could be operated at reduced power in such a case? Why the reactor will not be shut down in this case?

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
		prevent thermal damage to any target.	
			Response: This is a reduction in reactor power (to a certain percentage of nominal power) to maintain target temperatures within limits. The reactor could be operated under these conditions until the blower or other equipment is restored to normal operation, provided the safety system settings are not reached. The RPS will shutdown the reactor if a safety system setting is exceeded. The Power Reduction option is an alternative to a direct reactor trip and has been incorporated to allow small maintenance activities (e.g. start up by-pass equipment) without the problem of reactor poisoning.
11.36	11.4.3.1 Description	7th para – 'The flux perturbation level is less than 5%--'	Should it read thermal neutron flux? Is this 5% a calculated value or an empirical value?
			Response: This refers to a thermal flux. It is a calculated value.
11.37	11.4.3.2 Normal operation	4th para - 'SPND--'	Please describe this detecting system more clearly.
			Response: SPNDs (self powered neutron detectors) are devices that produce an electrical current proportional to the thermal neutron flux through the (n, β) reaction. These will be used for process monitoring only.
11.38	11.4.3.2 Normal operation	5th para - 'target cans --'	Is there any possibility of distortion of polythene-can during the irradiation process?
			Response: Experience of polythene used in the HIFAR NAA system at a flux of $2x10^{13}$ $n/cm^2/s$ for up to one hour has not indicated any distress to the cans.
11.39	11.4.3.3 Safety design provision	2nd para - a) '--- own active ventilation system'.	Please describe active ventilation system.
			Response: This system is described in detail in Chapter 10, Section 10.4.7.
11.40	11.4.4.1 Description	3rd para - 'flux flattening device'	Please describe more about this device.

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			Response: A sleeve made of aluminium with variable axial boron distribution to obtain a flat flux profile in the region where the silicon ingot is irradiated.
11.41	11.4.4.1 Description	Description of silicon ingots	What is meant by 'OD' in the Table? If it is 'Outside diameter', it should be spelled out in the Table.
			Response: Yes, "Outside Diameter".
11.42	11.4.4.2.2 Silicon ingot removal and transfer to service pool	2nd para - 'Auxiliary tasks'	Please explain
			Response: Foreseeable auxiliary tasks to be performed in the service pool are: a) Temporary storage of irradiated ingots. b) Si ingots extraction from their irradiation container (rig). c) ingot rinsing with demineralised water
11.43	11.4.4.3 Safety design provisions	1st para -'inherent safety design features--'	What are these inherent safety features?
			Response: The safety features are listed in the same PSAR section related to the potential incidents (bulleted from a to i).
11.44	11.4.4.3 Safety design provisions	h) Potential for a reactivity perturbation	What is the potential for reactivity perturbation for a Large and Very Large silicon ingots? What is the potential for reactivity perturbation in case of a removal of both silicon ingots (large and very large)?
			Response: Estimates of the reactivity perturbation expected due to the loading and unloading of the large volume facilities is presented in Chapter 5, Table 5.7/15. Perturbations are of the order 10-15 pcm.
11.45	11.4.5 Radioisotope handling	2nd para - 'unsealed sources'	Do these unsealed sources comply with the definition set out in the ARPANS Regulation.

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
	facilities		
			Response: Yes. Since silicon ingots are irradiated in unsealed cans in the LVF, they are referred to here as unsealed sources. A failure or an accident situation represents the case of a failure of a sealed target can.
11.46	11.4.5 Radioisotope handling facilities	7th para - 'The basic components of the hot cells are:---'	Isn't there any radiation monitoring devices?
			Response: Doses outside the Hot Cells are measured by the RMS; there are no personnel radiation monitors inside the Hot Cells. Radiation monitors are provided to measure target radioactivity prior to them being loaded into the hot cell transfer elevator (see Section 11.4.5.7.), and also in the hot cell prior to being loaded into the inter-building pneumatic transfer system for transfer to ARI (see Section 11.4.6.1).
11.47	11.4.5 Radioisotope handling facilities	9th para -	'Is the ventilation system powered by emergency power'?
			Response: Yes, the power supply will be backed-up by diesel generators.
11.48	11.4.5.1 Transfer hot cell	1st para -	What Standard was used in the design?
			Response: General basic standards have been applied. During the preliminary engineering stage the dimensions of the main shield bodies were determined by using calculations following international practices and using appropriate tools, conservative assumptions and by applying experience acquired in previous designs. The calculations being undertaken in the detail engineering phase, where shields, penetrations, channels and transitions are addressed, will be reported in the FSAR.
11.49	11.4.5.3 Pneumatic hot	4th para and 6th para -	Please mention Operational limits and conditions for PHC

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
	cells		
			Response: The operational limits and conditions for the hot cells will be addressed in Chapter 17 of the FSAR.
11.50	11.4.5.4 Loading hot cells	4th para -	Please mention Operational limits and conditions for LHC
			Response: The operational limits and conditions for the hot cells will be addressed in Chapter 17 of the FSAR.
11.51	11.4.5.5 Shielded flask containers	1st para -	Is there any Standard for the design? Is there any similar device in use at some other place?
			Response: No specific standards are identified for shielded flask design. Shielded flasks are used routinely at ANSTO and other nuclear facilities.
11.52	11.4.6.1 Description	3rd para - '40 GBq of Co-60'	Previously Na-24 was mentioned as reference. Why is the difference?
			Response: The Na 24 was used to define the maximum target for the hot cells but it was not expected that this level of activity would be transferred pneumatically external to the RRR building. The cobalt source provides the definition for pneumatic transfer limits.
11.53	11.4.6.2 Safety design provision	1st para -	Was any Standard followed for Inter-building Pneumatic Provision? How can the reliability be ensured?
			Response: No specific standard are known to exist for such applications. General standards applied are: 1. IAEA Safety Series "Safety Requirements for Research Reactors", Draft DS272, April 2000. 2. IAEA Safety Series 35-G2 "Safety in the Utilization and Modification of Research Reactors" (1994) Reliability is considered in the design through the provision of interlocks and controls to operate the system at both ends.

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
11.54	11.4.6.2 Safety design provision	2nd para - 'Can stuck in transit'	Is there any estimation of the dose to the to the people standing on the ground in the event of a can is stuck inside the transfer line?
			Response: Yes. The doses were calculated to fulfil the applicable requirements. Inside the facility premises a heavy concrete shield has been allocated to guarantee dose rates lower than 10μSv/h. Outside the facility buildings the system will run bellow a concrete slab through trenches deep enough to ensure dose rates acceptable for non controlled areas.
11.55	11.5 Neutron beam facilities	The CNS will use the well-proven natural – circulation liquid deuterium … concept …'	Please substantiate the words 'well-proven'.
			Response: A similar design is working at PNPI. Natural circulation systems are in operation at ILL, LLB, FRM-II, JAERI and other research reactors.
11.56	11.5.1 In plie beam assemblies	4th para - 'The design of the beam assemblies -- . These considerations include inherent safety design features---'	What design Standard was followed? Please describe the inherent safety features.
			Response: The inner part of the beam assembly, the beam tube, will be designed using the same standards applied to the reflector vessel as it is part of that vessel. Inherent safety features include: the selection of appropriate materials, the fabrication method (by welding to the reactor vessel), double barriers (dual bellows), moisture detection inside the beam tube, temperature monitoring, and grids above the bellows to protect from falling objects.
11.57	11.5.1.2.1. Description	14th para - 'The motor mechanism--'	Is there any indicator to detect the accuracy of rotation? Is there any manual system for rotation?

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			Response: The accuracy is guaranteed by the presence of a mechanical stopper. These stoppers are appropriately instrumented to indicate open or closed positions. Shutters can be rotated manually.
11.58	Fig 11.5/13	Typo error 'MOUVEMENT SCHEME'	Should be MOVEMENT
			Response: Agreed. This will be amended in the next revision of the PSAR.
11.59	11.5.2.1 Description	10th para - NGVS	Is there any monitoring system to detect malfunctioning of NGVS?
			Response: Yes – A sensor for each guide, automatic control of vacuum, and vacuum integrity maintained on power failure are provided (Refer Chapter 3, Section 3.10.11.3.2).
11.60	11.5.3.1.1 Cold Neutron Source In-pile Thimble	Neutron streaming through vacuum containment in the CNS	Possible neutron streaming through vacuum containment in the CNS should be calculated. Refer to Fig. 10.1/10 from Chapter 10. The calculations conducted as discussed in question (1) should be taken into account in dose estimations on the water surface.
			Response: Refer Chapter 15, Figure 15/17 – There is a reflector cell between the cold source and the thermosiphon to prevent streaming. Effect on surface dose rate will be negligible since a large amount of water is interposed between the CNS and water surface and constitute an appropriate shield for thermal neutrons.
11.61	11.5.3.1.1 Cold Neutron Source In-pile Thimble	'Alloys of zirconium and aluminium meet these requirements in the high radiation region, and also stainless steel in the upper (lower radiation) region'	In a view of above question regarding neutron streaming, neutron fluences and dpa should be estimated for zirconium and aluminium alloys and compared with the design criteria. What is the planned operation time of CNS? Has the CNS been designed for a reactor lifetime?
			Response: See response to Question 11.60. The CNS-Top Reflector will significantly

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			reduce the neutron fluence into the CNS upper stainless steel components. Neutron fluences and dpas on each component are being taken into consideration in the design, and radiation induced damage is being evaluated from their impact on the material's properties. The CNS In-Pile Plug is designed with a 10 year lifetime for the whole unit (source + thermosiphon). Their replacement is a planned operation also considered in the design.
11.62	11.5.3.2 Normal Operation	Change from SO to NO and vice versa	How often you envisage such changes? How long does it take to change from SO to NO? Please be more specific rather then saying 'several minutes' (as currently is said in Chapter 16, page 16.15-12)?
			Response: Approx 1 per month. Time taken will depend on reactor power. At full power may take several hours. Change will be smoothly controlled by the CNSCMS.
11.63	11.4.5.3.3 Safety Design Provisions	Tritium build up in the CNS	How you are going to cope with the problem of tritium build up in the CNS? What is the maximum permissible concentration of tritium in the deuterium circulating in the CNS? Did you take into consideration for CNS operation tritium presence in the deuterium? 1) Should some deuterium be released from the buffer tank due to overpressure, how much T associated activity may be released: • Into the reactor containment building; • Outside the reactor containment building?
			Response: From the operational viewpoint, there is no practical constraint on the maximum tritium concentration in the CNS-D_2. However, even when it is not a CNS operational problem, replacement of the tritiated D_2 is foreseen to meet radiological and safety requirements. The criteria on "when D_2 replacement shall be done" is closely connected with the

Question reference	Section number and name	Topic for clarification	ARPANSA Comment, Issue or Question and ANSTO's Response
			adopted solution for dealing with the extracted D_2. The entire CNS-D_2 moderator will be offloaded to the Deuterium Recombination System and be replaced with fresh gas. The resulting tritiated D_2O will be processed in the same way, and with the same procedures, as D_2O coming from the Reflector Vessel. The D_2 will be replaced when the tritium concentration in the resulting heavy water reaches $3.7x10^{11}$ Bq/lt, which is the maximum allowable value for the D_2O from the Reflector Vessel. It should be noted that tritium will be present as tritiated hydrogen gas whose associated radiological hazard is 10000 times lower than heavy water with the same activity (ANSTO Safety Directive 3.3. and EA-1086: Environmental Assessment for Amendments to 10 CFR Part 835). As a result the radiological consequences of a leak would be minor and are not considered further. 1). Concerning the possibility of D_2 releases from the CNS-D_2 Buffer Tank: the deuterium moderator loop, tubes and buffer gas are surrounded by a helium blanket (in-core part and piping to the nitrogen blanketing box) and a nitrogen blanket (the rest of the moderator system). This inert blanketing system contains deuterium and radiation detectors and pressure sensors so any leakage will be signalled to the RCMS. This system avoids contact between deuterium and the environment (air or water), and prevents tritium release to the Reactor Hall and Technical Floor, both of which are inside the containment. In the unlikely event of a leak occurring, the damaged zone will be isolated and the gas removed into the deuterium recombination system.
11.64	Figure 11.4/6-1	Figure or Table?	It looks like a Table rather than Figure.
			Response: This is intended to supplement information on Figure 11.4/6/2
11.65	Figure 11.4/6-1	Neutron flux	Is it a thermal neutron flux or total neutron flux? What are meant by Thermal and Fast columns in the Table? Say, if 'Thermal' is marked as blank and 'Fast' is marked as cross, does it mean that it is only fast neutron flux was estimated in the line corresponding to the next column marked as 'Neutron Flux"?
			Response: The fluxes given are either Thermal or Fast. This is identified on column 3 by the letter 'X'. All facilities except for two, are thermal flux facilities.

Attachment 11.1 Response to Questions 11.8 and 11.10.

International experience with CNS

CNS Location, since (year)	Moderator/working pressure	explosion safe vessel/design pressure
FRM, Garching, 1996	H_2 / 450 kPa	Vacuum / 1 MPa
FRM-II, Garching, 2001	D_2 / 300 kPa	Vacuum / 1.3 MPa
SFV, ILL Grenoble, 1971	D_2 / 300 kPa	Vacuum / 1.3 MPa
SFV, ILL Grenoble, 1991	D_2 / 300 kPa	Vacuum / 1.3 MPa
BER-II, HMI Berlin, 1991	H_2 / 1.8 MPa	Gas liner / 3 MPa
Orphèe, CEA Saclay 2 units	H_2 / 200 kPa	Vacuum / 1.3 MPa
KFKI, Budapest, 2000 PNPI / BNC	H_2 / 200 kPa	Vacuum / 1.5 MPa
WWR-M, Gatchina, 1970-1986 several PNPI	H_2 / D_2 200 kPa	Gas liner / 1.5 MPa
JRR-3M, JAERI, Japan, 1990	H_2 / 160 kPa	Vacuum / 2 MPa
LANSCE, Los Alamos	H_2 / 1.8 MPa	Gas liner / 1.5 MPa
FRG-1, Geesthacht, 1988	H_2 / 1.8 MPa	Vacuum / 3 MPa
HFIR, ORNL Oak Ridge, 2001	H_2 / 1.8 MPa	Vacuum / 1.9 MPa
NIST, Gaithersburg, MD 1995	H_2 / 300 kPa	Gas liner / 7.6 MPa
RRR, Australia	D_2 / 300 kPa	Vacuum / 3.2 MPa