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Subject Queries on the 1860A raised by the U.S. N.R.C.
Attention Mr J Miller

Dear John
Many of the questions raised by the NRC relate to welding procedures and notations on drawings. There are also a couple of typing errors. To make the changes to our document to suit your regulators will require a resubmission to ARPANSA, this is a headache that we do not want. We have had the discussion with ARPANSA on the best way to handle this issue. The best solution would be for us to make modifications to the drawings and answer the questions as a separate document.
The alternative will take some time but ARPANSA have agreed to us making the changes to the Safety Analysis provided we do not make any engineering changes and limit them to the issues of the couple of Typo's and the addition of the welding detail as this will not change the document and they will after the US approval, re validate the Safety Analysis as version 1.02

The questions raised indicates an unclear understanding of the Document
MODEL1860TYPE B(U)PACKAGE
SAFETY ANAYSIS, REVISION 1.10

The four main subject headings that are covered in the series of questions are

1. **The methods by which the procedures for welding are identified for the welding technicians.**
   a) Each style of weld is identified and a Weld Preparation Specification is designed to ensure compliance to AS/NZ 1554.6 1994 category 1B (III)
   b) Welding technicians are certified to carry out the welding procedures by doing a test weld under the supervision of a certified inspector. The test piece is destructively analyses by a Certified Laboratory to inspect and report on the test piece.
   c) A report of compliance is issued and the technicians certificate of competency is endorsed accordingly.
   d) It is not our practice to place all the detail of the weld procedure on the drawing, this detail appears at the required step in the construction manual.
   e) A construction manual for a Cask is prepared for every unit and issued a serial number at the commencement of construction. (Refer Pg154 of the Safety Analysis) The construction manual follows the Cask through every procedure of construction, from the ordering of materials and the the Q.Aing of the received parts, cutting, machining, welding, lead filling, labeling, finishing, bead blasting and final inspection. After each step the process is Q.Aed and signed off on the

drawing, first by the contractors officer, then verified by our Q.A. Engineer.

f) At the end of construction, the construction manual is scanned into the history file on our Server and the hard copy is filed away as verification of construction.
g) Our solution to the N.R.C. quire: We have produced a set of drawings marking them up to include welding detail, A set of drawings is attached to this letter. Also to make the detail more complete I have attached a copy of the Weld Procedures, the latest weld verification and report on the test samples for our welding technician. Note

2. Questions about the suitability of the sealing of the End Caps.

The seals are redundant to the approved application, as the Cask will only be used with special form material.

a) The Certificate issued by ARPANSA AUS/2007-13/B(U)-96 Paragraph 9 states, *The 1860A package is not authorized to contain fissile material. The authorized radioactive contents of the 1860A package are described in Appendix 2 and are to be in solid special form.*
b) As the contents will only be special form, the requirements of the enhanced immersion test (Paragraph 730 of TS-R-1) does not apply. Refer paragraph 640 which states *"Special form radioactive material may be considered as a component of the containment system"* This also applies to paragraphs 720 and 721.
c) As seals are not required for the transport of special form material the design does not require them and the detail relating to the seals is required only as evidence of the design procedures.
d) We have designed the package to have seals, (refer Pg 46 and paragraph 5 Pg 53 of the Safety Analysis) while they are not required, we have the feature as a secondary precaution on the extremely unlikely event of a compromised source.

3. Questions on the attenuation calculations.

For some reason the NRC is making the statement that a cask that cannot meet the Transport Index for the theoretical amounts requested, the cask is defective. This is not the way that we interpret TS-R-1, the amount of material that a cask can transport is the lower of the amount calculated at the first use survey or the amount on the Certificate.

a) Due to the extreme variability of attenuation data we used the most conservative data found (refer Pg15 Appendices), this was verified by comparison with the most used information on radiation practices. "ENGINEERING COMPENDIUM on RADIATION SHIELDING"
b) No detail has been found relating to 97% Tungsten (density 18.5). We used information derived from Sandvick (a Swedish Manufacturer) for 90% material (density 18) to derive our absorption curve.
c) Subsequently we provided a piece of material to International Isotopes. (12" dia with a 2" hole) This material was loaded with a 8650 Ci Co60 source and the Flux measured at the surface was 800mr/Hr. From our Graph we expected an attenuation of 200,000. from the actual figures measured an attenuation of 2^{19} was calculated. This makes our calculations even more conservative.
d) Paragraph 501(b) of TS-R-1 states that verification of the maximum amount of material that can be transported in the container is determined at the First Use Survey. Our determination procedure is set out on pages 60 and 237 of the safety analysis.
e) Verification of the value of our theory will be carried our in late January when we load Cask serial No 002 with 10,000 Ci of Co60.

f) We suggest the NRC calculation using Micro Guard was using density for 90% tungsten of 18.
g) In the event that the actual activity that can be accommodated is less than the Certificate amount. the certificate will be changed.

4. Questions on the use of the 1860A by sea and air.

a) ARPANSA is the primary agency in Australia for the certification of principles and practices for radiation. ARPANSA have issued the approval document AUS/ 2007-13/B(U)-96 which enables transport by road and rail, (refer paragraph 4b TRANSPORT RESTRICTIONS)
b) CASA is the regulatory agency in Australia for the transport of radioactive material by air. CASA has issued Instrument number, CASA 166/08 endorsing competent authority Identification mark AUS/2007-13/B(U)-96.
c) AMSA is the regulatory agency in Australia for the transport of radioactive material by sea. AMSA have issued document AP.5034 approving the use of the Transport Cask Identification mark AUS/2007-13/B(U)-96.for transport by Sea.

5. Questions relating to the end caps and test ports

a) The primary use of the 1860A is for moving point Sources up to 12,000 Ci Co60 in Treatment Center Source Drawers, the drawers are designed by others and radiation spill out the ends meet the requirements of the their designs. We have designed shine shields on the end caps to prevent shine from coming out the ends.
b) Where we have designed for Pencils in the 1860A configuration D the Sources are packaged in a canister and the end sources are much closer to the ends, this requires attenuation much greater than can be achieved using lead. These considerations are addressed on pages 124 through 133. Page 124 considers the field directly out from the center, Page 128 considers the source through the shortest path diagonally through the end with a three capsule pencil, page no 130 considers the case of several points round the end quadrant for a seven source pencil and page 131 considers the requirement through the end using a 70mm side attenuator of 97% tungsten with a 127mm steel canister filled with lead. A shine shield is incorporated into the end caps.
c) The test ports are designed to satisfy the requirement for ensuring a source is not compromised prior to downloading. There is no intention to attempt to wipe the source as suggested in question 1.5
d) Question 1.1 paragraph 3 sugests that the point of measurement at the end crumple Shield should be should be taken from the end cap not the outside of the crumple shield. As the hands are the only part of the body that can get close to this area and the allowable absorbed dose for the hands is 10 times higher than whole of body the inference is inconsequential.

Specific answers to the Questions in the N.R.C.
REQUEST FOR ADDITIONAL INFORMATION

1.1 Our advice when attempting to obtain the best information on attenuation for various materials was that we should build in a safety margin and use the most conservative information available. The probable outcome will be that that we will have a low Transport Index with the maximum activity designed for. At First Survey any issues will be addressed by actual measurement. Refer paragraph 3 above.

A query is raised relating to the entire source strength (see Page 128 – 133). The application referred to is for 3 sources in a configuration D Cask which has a maximum design of 15000 Ci as explained on page 124, the series of calculations extends through to

a cluster of 7 pencils that have 7 capsules our calculation shows that we could load up to 19242 Ci. A practical limit with these pencils is 250 Ci per source or 1750 Ci per pencil or a total of 12250 Ci.

Source Drawers will usually be designed by others and will have to comply with regulations where unbadged personnel frequent and therefore will be an order lower than required for a transport index of 10. In all cases the overriding factor is the Transport index.

It is noted that you identify the accessible package surface at the ends, is the end caps not the crumple shield. We content that the only part of the body that could reach this area is the hands and allowable exposure limits are 500mSi/year an impossible figure to reach and the more practical criteria is whole of body, which can only reach the crumple shield.

1.2 Refer paragraph 3 above. If the first use is to transport a spent source, a reasonably accurate assessment of the activity of the source can be determined and the transport index accurately measured, transport index is the governing factor.

1.3 The issues listed are application criteria and as such are in the control of the local regulators and do not impinge on the safety of the cask.
We have specified that we require this information prior to it's use, failure to provide this information puts further use by that client at risk.

Local regulators set the parameters in their area of jurisdiction, therefore there may be additional criteria that could apply that we have not considered, this detail would also have to be adhered to.

1.4 We send in the tool box attached to the Cask manuals specific to issues related to the correct use and transport of the Cask but not related to the integrity of the cask. These include basic Radiation procedures, Accident avoidance, Emergency response, Transport check lists and procedures, these manuals are appropriate but the local regulators make the rules, we can only advise.
We do not wish to have a contaminated Cask therefore we require as part of the use of the cask to have tests at every milestone be it receival or dispatch, loaded or empty.
We cannot provide work procedures for all applications we must rely upon the knowledge and experience of the user to put in place the appropriate work plan.
Where we have control of all aspects of a job we prepare appropriate tools for the task.
Pages 695 and 697 show how we attach two Casks together to transfer a source Drawer.
This has nothing to do with the Cask integrity.
The 1860 will not be provided to a client until their credentials to handle radiation have been checked and they provide the appropriate license to handle the task in hand.

1.5 Our stated procedure prior to shipping the Cask is a wipe test on the end of the material installed in the Cask. This would be either the end of a drawer or in the case of a capsule/pencil holder the end of the attenuator. Under no circumstances would there be an attempt at removing attenuation with out the appropriate tools and work procedures.
Integrity of the capsule is the province of the capsule manufacturer.
While it is most unlikely that a capsule would become compromised between the fabrication lab and an application site we don,t want to be the ones to spread the contamination, therefore we have designed in the test port (small opening) and the procedures at each movement to check the integrity of the Cask.

2 Thermal

2.1 These calculations were carried out by ANSTO, the calculation that uses the figure 0.26 is to calculate the surface temperature of the attenuator case with 250W to be dissipated.

2.2 Oven temperature was measured using a thermocouple attached to the top of the Cask mash on the end closest to the door, as there was only a small mass the temperature was considered to be the air temperature. (see Photograph Pic10 page16 of ANSTO report) the Instrument used had a current calibration certificate (refer Original Test Data Record QCP0717 page 18 of ANSTO report) and was used as a certified record of the thermal environment.
The oven sensor temperature was the reading of the temperature controller (uncertain accuracy). The test did not commence until the thermal environment had reached 800°C. It is safe to assume that the total environment was in excess of 800°C as the flame was at the back of the oven, the controller temperature read in excess of 870°C for the duration of the test. There is not a requirement on the test as described in TS-T-1 728a to measure the surface temperature of the unit under test.

2.3 The oven was evaluated by the testing authority ANSTO (Australian Nuclear Scientific and Technical Organisation) who are the Australian Governments Engineering Authority and are responsible for carrying out this type of activity for all Australian Government Instrumentalities. They decided the oven was suitable for the application.

2.4 It is not clear what this paragraph is questioning as TS-R-1 652 relates to the temperature limit on the outside of the package and shall not exceed 50°C when transported by air.
Thermal analysis is discussed on page 96 of the Safety Anaysis.

2.5 We have approval for Special Form Material and therefore operating pressure of the Cask is irrelevant, however we have retained the metal seal which will retain sealing in excess of 20MPa.

2. As for 2.5 above.
The reference URL on page 25 of the ANSTO document worked in 2005 when that document was created, there has been changes to our web sites this link will be investigated and reestablished as we bring on line our down loadable documentation that is required for use with the Cask

We cannot comment on the apparent discrepancy, however checking the numbers using both formula shows a variation at the end of the fin of 1° from 39° to 40°

3 Structural

3.1 We would anticipate a reasonable life cycle for the 1860 Cask to be 20 years.
A mission cycle would on the average be 6 weeks with one down load and one upload. With full utilization of the cask this relates to 175 missions or a maximum of 350 up loads and down loads.
Reality would be less than this as there will be longer turnarounds due to site conditions plus there will be maintenance periods and times when it is not required. This is a frequency that even under the most difficult periods of vibration (which will be infrequent) will not come close to the window of stress fracturing.

3.2 Reference to 403 is a typographical error the correct detail is shown on drawing Number 1860A-01-181 as 316.

3.3 Due to complex arguments relating to the integrity of the seals our application was revised for Special Form Material which uses the source as part of the containment as allowed refer TS-R-1 paragraph 640 and explanation in 2a above.

Our original design was to use Neoprene “O” rings. The manufacturers will not provide absolute seal specification as the sealing capability is determined by the tolerance of the machining. We were able to obtain some detail that assued us that the seal was more than adequate for 20MPa.
It was argued by ARPANSA that the seal would be compromised after a fire and would no longer hold 20MPa. An 800°C fire that lasts for ½ Hr than subjects the Cask to 20MPA is a difficult to envisage. However we changed the design to incorporate a metal seal constructed of a 316 stainless steel “V” coil loaded with graphite that was suitable for sealing against 350 Bar when raised to 850°C. As the manufacturer had only tested the seal on containing pressure not preventing ingress we decided that we would only use the Cask for the transport of Special Form Materials.
While the seals are redundant to our approval we have retained the seals as a secondary protection in the unlikely event of a source becoming compromised.

4 Materials
4.1 All welding procedures comply to AS/NZ 1554.6 1994 category 1B (III).
Welding technicians are certified to carry out the welding procedures by doing a test weld under the supervision of a certified inspector. The test piece is destructively analyses by a Certified Laboratory to inspect and report on the test piece.
A report of compliance is issued and the technicians certificate of competency is endorsed accordingly.
Attached to this document are Weld Procedure Specifications and current test reports for the technician that manufactures our equipment. It will be noted that the current endorsement is also for AWS D1.6 2007

4.2 Reference to 440 is a typographical error.
The Stainless Steel used for the cask proper is 316L. 304 Stainless steel is used in the base where corrosion resistance is not as important. We are at a loss to explain how 440C appeared on the documents.

4.3 The filling port flange is not welded to the drawer tube at this stage.
When the Cask is filled with lead, due to expansion and contraction of the case and drawer tube, the parts are allowed to move to ensuring there are no stresses placed on the end flanges, the Cask is allowed to cool prior to welding the drawer tube to the filling port end flange.
To complete the construction the bore of Configurations A B C & D are line bored to ensure a bore free of defects. All configurations have the end flanges machined flat and square to the bore. Refer construction manual.

4.4 Refer 3.3 above.

4.5 Refer construction manual
There are no points that can be considered a “*crud trap*”. The end caps are two machined surfaces with a seal refer 3.3. In addition the cask is to be steam cleaned between missions.

4.6 Refer 3.3 above

4.7 Refer 1d &g above and the Construction manual.

4.8 The Tungsten Attenuator attachment to the Drawer Tube halves is by bolted machined surfaces. The concept of fusing the interface is a secondary procedure to ensure lead cannot weep through this interface during the lead pour. Welding to 97% tungsten is ineffective (as pointed out in your request for information) Due to differential contraction the fusing process using stainless steel filler rods, cracks, experimentation using mild steel filler and a procedure to minimise heat build up is employed. The filler rod is layed down for 12mm, then 12mm on the opposite side, after being allowed to cool two additional beads are laid down, after cooling two additional beads at 45°are laid down. After repeated stitches slowly filling in the gaps the seal is complete.
This back up mechanism is redundant after the Cask is filled with lead.

4.9 Refer construction manual.

4.10 Part No 1860A-01-120 is manufactured from 316 stainless steel, the drawing has been corrected.

4.11 Refer 3.3 above.

4.12 Parts with component number 1864 are tools built to effect an easy field transfer of a Theratronics 780 Source Drawer and plays no part in the design and safety of the Cask.

4.13 Refer construction manual.

4.14 Refer 4 above (Questions on the use of the 1860A by sea and air.)

Additional information
5.1 As an aid to the user we provide the following manuals
Emergency Response Manual.
Engineering Users Manual.
These manuals are not designed to meet the requirements in all jurisdictions, or the inhouse work practices, it is meant as a guide to the user, local regulators are responsible for the practices in their area of responsibility and have an over ride over detail in our manuals.

To enable a complete answering of the questions, we have provided a copy of the construction manual for an 1860A-C. copies of our weld procedures, the test report for our welding technician plus all the drawings we have enhanced by the addition on the Weld procedure information to U.S. Requirements.

We trust all points have been covered to the satisfaction of your regulators.

Yours Faithfully

E.T. Parrott