Disposal Solutions for Metal Scraps Derived from Treatment of Irradiated Sodium Bonded Fuel

1. Quality Level (QL) No. X
2. QL Determination No. X
3. Engineering Job (EJ) No. X
4. SSC ID X
5. Building X
6. Site Area X

7. Introduction:
Management and eventual disposition of the metal cladding resulting from the treatment of irradiated, sodium-bonded metallic fuel is one of the challenges associated with the electrometallurgical treatment process. Baseline planning for this eventual disposition has focused on immobilization of the metal clad in a durable, homogeneous metal ingot known as the metal waste form (MWF) for placement in a geological repository such as Yucca Mountain. Recently, with the Yucca Mountain repository licensing activities suspended, alternatives for metal cladding disposal are being considered. These include evaluation of the metal clad for potential disposition as Remote Handled-Transuranic Waste and/or Remote Handled Low Level Waste, in ingot form, or possibly as cladding after electrorefining without further processing. This report evaluates the various options and provides recommendations for continued pursuit of a permanent disposition strategy for cladding.

8. If revision, please state the reason and list sections and/or pages being affected:
   n/a

9. Conclusions/Recommendations:
A review of the initial characterization data returned from cladding hull analysis supports consideration of disposition of the existing material as either RH-TRU in the WIPP repository or possibly as RH-low level waste at the Nevada National Security Site.

Although there are advantages to producing a homogenous metal ingot through the consolidation of several batches of cladding hulls, there may be an opportunity to disposition the cladding packaged as individual units, as opposed to a consolidated ingot.

Size of MWF ingots could have an impact on their ability to meet acceptance criteria at either WIPP or the NNSS with favorable consideration being placed on an ingot smaller than that currently produced in the metal waste form furnace in HFEF. It is recommended that a trial ingot be produced using the cathode processor and casting furnace in FCF using clad from recently processed batches of U-5Fs fuel. In parallel, additional runs should be performed in the MWF furnace in HFEF with possible consideration of a smaller crucible size.
Timely sampling and analysis of future MWF ingots should be conducted to quantify fissile content of ingots and support development of a model that could be used in place of cladding hull sampling, post electrorefining, in the future.

Additional analysis regarding sodium residing in the plenum sections after removal from the intact element should be conducted. Analysis should include plenums from recently processed elements, as well as those from batches processed several years ago, in attempt to quantify the extent of oxidation that may have occurred in the sodium. This data would be used to help determine the best treatment method (distillation or perhaps electrorefining) for plenums.

To help alleviate storage constraints in the FCF argon cell, additional packaging configurations should be considered that would support relocation of the plenums for interim storage out of the cell.
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APPENDIXES
Disposal Solutions for Metal Scraps Derived from Treatment of Irradiated Sodium Bonded Fuel

TEV No.: 2218  Rev. No.: 0  Project No.: 31059  Date: 09/30/14

PROJECT ROLES AND RESPONSIBILITIES

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<th>Project Role</th>
<th>Name (Typed)</th>
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<td>Document Owner</td>
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Responsibilities

a. Confirmation of completeness, mathematical accuracy, and correctness of data and appropriateness of assumptions.
b. Concurrence of method or approach. See definition, LWP-10106.
c. Concurrence with the document’s markings in accordance with LWP-11202.
d. Concurrence of procedure compliance. Concurrence with method/approach and conclusion.
e. Concurrence with the document’s assumptions and input information. See definition of Acceptance, LWP-10200.

NOTE: Delete or mark “N/A” for project roles not engaged. Include ALL personnel and their roles listed above in the eCR system. The list of the roles above is not all inclusive. If needed, the list can be extended or reduced.
1. **INTRODUCTION**

As part of the planning for the treatment and management of used sodium bonded metallic fuel, significant research has been undertaken to develop durable waste forms for the salt and metal by-products generated as part of the treatment process (ref. 1). One of the key premises of this planning has been that the subsequent waste forms would be dispositioned as High Level Waste forms in the Yucca Mountain Repository in Nevada (ref. 2). The decision by the Administration to suspend pursuing licensing of the planned repository has provided an opportunity to reconsider the baseline approach developed for the eventual disposal of the by-products. This paper will focus on disposition of the cladding hulls and plenums derived from the processing of used sodium bonded metallic fuel. The baseline approach for disposition of this material had been through the development of a homogeneous metal ingot created from the consolidation of several batches of cladding hulls in an inductively heated high temperature vacuum distillation furnace.

Research and development of the metal waste form was initiated at Argonne National Laboratory (ref. 3, 4] during the 1990s and continued through various stages of in cell and out cell surrogate demonstrations, finally culminating with the production of the first full scale ingot made from irradiated cladding hulls in the Hot Fuel Examination Facility (HFEF) in August of 2011. The photos in Figure 1 below provide an illustration of the constituents and equipment used in creating the ingot in HFEF.

![Metal Waste Process Diagram](image)

*Figure 1. Baseline metal waste form process for cladding from used, sodium-bonded metallic fuel.*
The delay in licensing for the Yucca Mountain Repository has allowed the program to have a 2nd look at the proposed disposition for the cladding and plenums and consider if additional characterization could provide alternatives to the previous strategy. A review of the existing inventory appears to support the potential disposition of the metal ingot, and possibly the cladding prior to consolidation into an ingot, as either Remote Handled Transuranic (RH-TRU) waste, or Remote Handled Low Level Waste (RH-LLW). Based on these possibilities, the program is now pursuing a strategy aimed at exploring the steps and data necessary to qualify either the ingot, the clad, or potentially both for permanent disposal in either the Waste Isolation Pilot Plant (WIPP) in New Mexico, or the Nevada National Security Site (NNSS) in Nevada. The future RH-LLW facility to be built at the INL may also be a consideration.

Initial looks at acceptance criteria for both destinations appear to favor radiological limits lower than those that would commonly be associated with ingots being produced by the current configuration of the Metal Waste Form Furnace in HFEF. Thus, as part of the strategy, the current configuration of the equipment will be evaluated to determine if smaller crucibles and smaller batch sizes should be considered, and also whether existing equipment in FCF (Cathode Processor & Casting Furnace), or possibly new equipment, could contribute to a successful disposition.

In accordance with the definition for cladding hulls and plenums derived from the processing of used nuclear fuel in the Fuel Conditioning Facility (FCF) (ref. 5), the term “metal scraps” will be used in this document except in reference to the previously cited research on “metal waste”. A detailed background to the metal waste will be bypassed as it has been documented extensively elsewhere (refs. 2-9). The purpose of this document is to update the status of the metal scraps since creation of the 1st metal ingot from irradiated material in 2011 and provide a path forward for future operations related to the metal scraps.

### 1.1 Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>BHS</td>
<td>Blanket Hull Storage</td>
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<tr>
<td>CWF</td>
<td>Ceramic Waste Form</td>
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<tr>
<td>DOE</td>
<td>Department of Energy</td>
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<tr>
<td>EBR-II</td>
<td>Experimental Breeder Reactor II</td>
</tr>
<tr>
<td>EMT</td>
<td>Electrometallurgical Treatment</td>
</tr>
<tr>
<td>ER</td>
<td>Electrefiner</td>
</tr>
<tr>
<td>FGE</td>
<td>Fissile Gram Equivalent</td>
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<tr>
<td>HFEF</td>
<td>Hot Fuel Examination Facility</td>
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<tr>
<td>INL</td>
<td>Idaho National Laboratory</td>
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<td>INTEC</td>
<td>Idaho Nuclear Technology and Engineering Center</td>
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<tr>
<td>MFC</td>
<td>Materials and Fuels Complex</td>
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<tr>
<td>MTHM</td>
<td>Metric Ton Heavy Metal</td>
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<tr>
<td>MWF</td>
<td>Metal Waste Form</td>
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</table>
2. BACKGROUND

Since the commissioning of the EMT equipment in FCF in the mid 90’s, more than 4.5 of the 25.5 metric tons heavy metal (MTHM) EBR-II sodium bonded used fuel inventory has been treated via electrorefining and has created nearly 650 kgs of metal scraps. While this has included both driver fuel and blanket material, the majority of the metal scraps generated in the near future will be from driver fuels.

Two full scale metal ingots have been produced from the existing inventory of metal scrap while enough material remains to support the creation of 16 additional ingots. The amount of metal scraps will continue to grow in accordance with the projected increase in treatment rates which targets 2 MTHM driver fuel to be treated by 2023. Currently, the metal scrap material is stored on an interim basis in the argon cells of FCF and HFEF due to the presence of the hygroscopic salt on the exterior of the cladding after electrorefining. The continued accumulation of the scrap material is an area of concern from both a physical space requirement as well as radiological inventory. The current metal waste process utilizes a unique furnace design to accomplish distillation (removal) of the salt from the exterior of the clad, while also melting the clad into the resulting metal waste ingot. Salt removed from the metal scrap is transferred back to FCF and recycled into the electrorefiners while the metal waste ingot is placed into interim storage in the hot cell with eventual plans for transfer to the Radioactive Scrap and Waste Facility (RSWF) for continued interim storage.

The plenum portion of the metal scrap is currently managed in much the same manner as the cladding; placement into metal containers for interim storage. The recipe for production of the metal waste ingot has been designed to accommodate the plenum portion, however there are some concerns that the residual sodium in the plenum section may come in contact with the graphite components of the Metal Waste Furnace having a negative effect on the components. No plenum sections were included in the two metal waste ingots produced thus far.
Finally, current material balance requirements necessitate extensive sampling of the clad portion of the metal scrap to provide information on the composition of the scrap. Upon collection of the samples, they are weighed and subjected to chemical analysis. The sampling and analysis evolution is costly and time consuming. It has been suggested that the quantification of the metal scraps could be improved significantly by implementing timely consolidation of scraps into an ingot and subsequent sampling of the metal waste ingot for analytical chemistry data. Resource constraints in HFEF, as well as the analytical laboratory have resulted in significant lag between the time a batch of fuel is electrorefined and the resulting metal scraps are melted into an ingot. Additional delays are experienced in collection of the sample and analysis of the material. If this duration can be reduced, it is assumed that cladding hull sampling could be discontinued in FCF saving the project considerable sampling and analysis time and effort. It should be mentioned that one other option exists for quantifying the fissile fraction of the metal scraps; modeling could be utilized to replace the cladding hull sampling efforts given the model is validated with sufficient data.

### 3. EVALUATION

#### 3.1 Cladding Hull Disposition

In an effort to alleviate the continued interim storage, the program is engaged in reviewing the previous strategy and assumptions regarding the metal scraps created through the treatment of irradiated sodium bonded fuel. The Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306) and the corresponding Record of Decision documented the assumption that the cladding hulls and plenums would be classified as high level waste and was supported by an extensive developmental program which provided the equipment, the process, and the resulting waste form (ref. 2). Over the past several years, the designation has been reevaluated internally and consultation has been sought from DOE-HQ Environmental Management division for their thoughts. Correspondence between DOE’s Martin Letourneau and INL Waste Management specialist Bruce Adams is copied below:

> Cladding hulls are not HLW. Many steps before and after reprocessing of SNF do not result in HLW, and (DOE M) 435.1 fully intended that removal of cladding hulls (however it is done) does not result in them being HLW. Even if they are contaminated with some fission product residuals, they are not HLW. The only step in the process that results in HLW is the actual reprocessing because it is at that point that the fission products and actinides exist together in the highest concentrations. It is not until the hulls have been removed, useable uranium has been removed and any other useable products have been removed that HLW exists.” (Email correspondence: from Martin.Letourneau@em.doe.gov to Bruce.Adams@inl.gov, June 17, 2011).

Thus, from the correspondence it is evident that sufficient support exists to continue the development of a strategy that considers the metal scraps exempt from high level waste consideration and that a path which manages the metal scrap as either RH-TRU of RH-LLW, as characterization dictates, is appropriate.
A preliminary analysis comparing the waste acceptance criteria (WAC) for WIPP and NNSS with the nuclide concentration of the of the existing metal scrap inventory has been conducted to determine the limiting factors. (ref. 13) The factors that were examined include total Curie content, FGE, PEC, and decay heat. Table 1 lists the FGE, PEC/PEG, and decay heat requirements applicable to the RH-TRU waste disposed at WIPP as well as LLW disposal at NNSS.

Table 1. WIPP RH-TRU disposal criteria and NNSS LLW disposal criteria.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>WIPP WAC</th>
<th>NNSS WAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{239}$Pu FGE/$^{235}$U FGE</td>
<td>315 g $^{239}$Pu FGE</td>
<td>350 g $^{235}$U FGE</td>
</tr>
<tr>
<td>PEC/PEG for Solidified Waste</td>
<td>1800 Ci</td>
<td>300 PEG</td>
</tr>
<tr>
<td>PEC/PEG of All other Wastes</td>
<td>240 Ci</td>
<td>300 PEG</td>
</tr>
<tr>
<td>Decay Heat</td>
<td>$\leq$50 W</td>
<td>Not given in WAC</td>
</tr>
</tbody>
</table>

The results of this analysis indicate that 98% the cladding portion of the metal scrap inventory potentially meet the WIPP WAC or the NNSS WAC based on radiological constituents (ref. 13). While this analysis is by no means complete, it indicates that direct disposal of the cladding after electrorefining is option that merits further investigation.

Even though direct disposal of the cladding portion of the metal scrap may be possible, there are several advantages gained through the creation of a uniform, homogenous metal ingot that may justify the continued practice of creating an ingot from the consolidation of the cladding. These advantages include cost for disposal, reduced radiological dose (through removal of the salt), increased material accountability, improved form for storage, and overall volume reduction.

Current cost estimates for disposition of RH-TRU waste from the INL indicate that it is approximately 2 times greater than disposition costs of LLW. This comparison may become even more favorable with respect to LLW as details emerge about the waste acceptance criteria for the RH-LLW facility planned for operation at the INL in FY2019.

Removing salts reduces the overall activity of the resulting ingot due to some actinides being retained in the salts, and the removal of volatile fission products, creates a more disposal ready waste form, not subject to rejection due to radiologic profile or concerns over high salt content found in some BHSs/PSCs.

As mentioned previously, the nuclear material control plan for FCF requires sampling of the cladding hull segments after electrorefining to determine the amount of residual uranium retained in the clad as well as the fraction of salt adhering to the cladding. This data is intended assist in the material balance requirements process as well the tracking of special nuclear material inventories (SNM). The sampling and corresponding destructive chemical analysis is time consuming and thus costly both from a labor perspective as well as waste disposition. Drill sampling of an ingot created from consolidated cladding, and the subsequent destructive chemical analysis provides a more accurate representation of the residual uranium remaining in the processed cladding, as well as reduced sampling, analysis, and waste disposal costs.
The hygroscopic nature of the salt adhering to the surface of the clad requires it to be stored on an interim basis in a sealed container and to remain in the dry atmosphere of the HFEF and FCF argon cells. As mentioned previously, this creates challenges with respect to both physical space constraints as well as radiological inventory. Competition for physical space within the cells continues to increase due to an increase in the number of projects and programs conducting work in the cells. Additionally, both HFEF and FCF have limits regarding the amount of nuclear material that can be present in the cell. The term related to this limit is known as “Material at Risk” (MAR). The cladding portion of the metal scrap is considered material at risk and thus counts against the established MAR limit for the cell. Consolidation into ingot form reduces the physical storage space requirement, and by removal of the salt, allows for the ingot to be considered for relocation to RSWF for interim storage.

The equipment used to consolidate the cladding into ingot form, primarily the Metal Waste Form Furnace, is located in HFEF and provides a significant reduction factor from a consolidation perspective. Approximately 6 containers of cladding can be consolidated into 1 ingot produced in the furnace. While this 6 to 1 reduction factor is viewed as a significant benefit in terms of handling and storing, the average fissile gram equivalent associated with the average size (75kg) ingot is above the acceptable limit for both WIPP & NNSS. Thus smaller ingot sizes, in conjunction with a mixing and matching of cladding containers to produce an ingot with the lower desired FGE will be investigated.

Engineering is currently underway to utilize equipment that will remove the salt adhered to the cladding surface in FCF prior to transfer to HFEF. The intent is to improve the handling efficiency in HFEF, as well as minimize any potential concerns associated with the unintentional spread of contamination that may be associated with handling the salt laden cladding.

Utilization of the equipment in FCF to contribute to ingot formation may also be expanded beyond salt removal. The Cathode Processor (CP) and Casting Furnace (CF) of FCF were previously used in a limited number of experiments to establish the viability of the metal waste ingot process prior to designing the equipment in HFEF. While this equipment was designed specifically to remove salt through distillation of the dendrite recovered from the ER and then cast the uranium recovered from processing into a final shape and enrichment, it may also be capable of producing a metal waste ingot of smaller physical size (5kg). The corresponding radiological properties may prove be advantageous toward meeting the waste acceptance criteria of either permanent disposal facility. Other advantages regarding the potential use of the FCF equipment would be the elimination of the additional handling steps required to send metal scraps to HFEF and receive back the salt removed from the clad, as well as elimination of the resource constraints brought about by competition between programs conducting work in HFEF. Disadvantages to using the FCF equipment are primarily attributed to impacts on the rate of treatment operations occurring in FCF. Both the cathode processor and casting furnace serve unique functions in the EMT process. Expanding the usage of both pieces of equipment to support creation of metal waste ingots may have a negative impact on the rate of treatment. Additionally, the expanded role of the CP & CF would be beyond the original design criteria of the equipment and should be analyzed to determine if this could lead to a significant reduction in the operating life of the equipment. This may be of special concern as the rate of treatment is forecast to increase in an effort to support enforceable milestones between DOE and the State of Idaho related to eliminating wet storage of used fuel, and removal of used fuel from the State. This may also lead to the consideration of new equipment to be installed in FCF, or modify the existing equipment to better accommodate making metal waste ingots from the metal scraps generated during EMT processes. It may be possible to consider expanding the role of the new equipment to better accommodate the removal of sodium from the plenum portion of the metal scrap inventory, as well as full length blanket elements.
3.2 Plenum Disposition

The plenum section of a fuel element is created by the chopping operation in FCF and is located above the fuel and sodium regions. Not all of the metallic sodium is included in the chopped fuel segments; a residual amount remains adhered to the interior walls of the cladding above the sodium meniscus level. This residual sodium ends up in the plenum sections and varies in quantities depending on fuel type, inner diameter, and irradiation history. Shown in Table 2 are the residual amounts of sodium in plenums for various fuel types. The data are based on sampling except for the FFTF driver which was derived from process knowledge.

Table 2. Residual sodium in plenums for various fuel types

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Diameter (in)</th>
<th>Burnup (a/o)</th>
<th>Sodium (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanket-EBRII</td>
<td>0.433</td>
<td>&lt;0.2</td>
<td>31</td>
</tr>
<tr>
<td>Driver-EBR-II</td>
<td>0.196</td>
<td>8-10</td>
<td>4</td>
</tr>
<tr>
<td>Driver-FFTF</td>
<td>0.23</td>
<td>10-14</td>
<td>67</td>
</tr>
</tbody>
</table>

*Based on plenum sampling except FFTF fuel

When it was assumed that metal scraps (cladding and plenums) would be classified as high level waste, the plenum stream was proposed to be incorporated into the metal processing operation by oxidizing the residual elemental sodium in the plenums with iron chloride during a typical metal processing cycle, followed by salt distillation and consolidation as normal for the cladding hulls. It was recognized at the time that a risk existed of elemental sodium reacting with the graphite components of the metal process furnace either as a liquid or gas; both of which are known to cause significant degradation of graphite by the formation of interlamellar compounds. A limited number of tests were performed during the process qualification (ref. 8) with elemental sodium and iron chloride that showed no apparent damage to the graphite components of the furnace although the feed materials were only surrogate in nature. Given the change in status of metal scraps from high level waste to either potentially RH-TRU or LLW, the incorporation of plenums into the metal processing cycle would no longer be necessary, particularly since plenums contain no fuel constituents. If oxidized, the sodium in the plenums would be neutralized and the plenums could be easily dispositioned.

Given the spatial limitations in FCF with respect to plenum storage, an immediate issue exists to their interim disposition. Near term, it is suggested that the plenums be packaged in breached element type containers and sent to RSWF for safe interim storage to allow continued processing of U-5Fs fuel in FCF. Also near term, it is suggested to sample and characterize the U-5Fs plenums and confirm their sodium content since the U-5Fs fuel encompasses over half of the driver to be processed in FCF. Characterization includes determining the extent of elemental sodium oxidation in FCF in order to assess the long term options.

Long term plans for the plenums may include either distillation of elemental sodium in equipment similar to that being developed for sodium removal from unirradiated EBR-II fuel and TREAT loops at INTEC or treatment similar to the non-candidate fuel that is oxidized in the FCF electrorefiners at the end of used fuel processing. The distillation path would require new equipment which would most likely need to be remotized for use in FCF. For oxidation in the electrorefiners, it is assumed that new baskets
would be necessary to accommodate the longer plenums in addition to the cathode processor if salt removal is necessary from the plenum prior to disposal. Also for oxidation, testing should be performed with closed and open ended plenums to determine the extent of wetting as well as oxidation of the sodium in the plenums.

4. CONCLUSIONS

Permanent disposition of cladding hulls and plenum sections created as part of the electrometallurgical treatment process appears to be achievable as either RH-TRU at WIPP or RH-LLW at NNSS, or possibly some portion of the inventory to both locations. Additional characterization is needed both for the metal ingot, as well as individual cladding and plenum sections to firm up the indications provided in the preliminary analysis.

The potential exists for cladding hulls to be disposed of without the need for further processing or creating ingots. From a strictly waste disposal path, there is no restriction on cladding hulls, as they currently are. The only restrictions appear to be the same restrictions that would apply to ingots namely, characterization, mass, dose rate, source term, etc. This path forward may be acceptable and prove more beneficial for scheduling and costs, to remove the necessity of creating ingots. However, creating ingots does offer some advantages, such as: removal of residual salt, lowering the dose rate, allowing for better sampling data to be obtained, consistent waste form configuration, and consistent packaging.

Additionally, as discussed during the characterization of cladding hulls, the option may exist to use the Fuel Casting Furnace in FCF as an alternative to the MWFF in HFEF. The use of the FCF fuel casting furnace provides more flexibility in the shipping and configuration, for disposal, of the ingots generated. The relative size of ingots created in the MWFF, make them difficult to realize the volume reduction potential (which was originally a positive impact for the metal ingot process) for shipments to a disposal facility. The smaller ingots allow for better optimization of the inventory without further need to manipulate the MWFF or the resulting ingot (e.g., sectioning, or cutting into smaller pieces, creating a smaller crucible, or crucible insert).

Constraints on in cell storage locations for interim storage of the existing metal scrap inventory will continue to cause challenges with respect to material management in the hot cell. This concern is expected to increase as the rate of treatment of sodium bonded used fuel in FCF is expected to increase. Use of resources (both personnel and equipment) in HFEF to produce the metal ingot continues to be in conflict with other missions being executed in HFEF and is predicted to become more problematic as the workload of other programs in HFEF is expected to increase.

The plenum portion of the metal scrap inventory also contributes to the material management challenges in the hot cell. While originally intended for disposition as part of the metal waste ingot, more efficient disposition may be achieved through distillation of the sodium from the plenum.

5. RECOMMENDATIONS

The program intends to focus on pursuit of permanent disposition of the metal scrap inventory, primarily the cladding hull portion, via the existing RH-TRU repository at WIPP or the RH-LLW repository at NNSS. Key to supporting this pursuit is the generation of additional data to help more fully characterize the existing metal scrap inventory, the projected increases to be made through increased treatment of driver fuels in the near term, as well as future metal waste ingots.
With the realization that size of MWF ingots could have an impact on their ability to meet acceptance criteria at either WIPP or the NNSS, it is recommended that a trial ingot be produced using the cathode processor and casting furnace in FCF using clad from recently processed batches of U-5Fs fuel. In parallel, additional runs should be performed in the MWF furnace in HFEF with possible consideration of a smaller crucible size.

Timely sampling and analysis of future MWF ingots should be conducted to quantify fissile content of ingots and support development of a model that could be used in place of cladding hull sampling, post electorefining, in the future.

Additional analysis regarding sodium residing in the plenum sections after removal from the intact element should be conducted. Analysis should include plenums from recently processed elements, as well as those from batches processed several years ago, in attempt to quantify the extent of oxidation that may have occurred in the sodium. This data would be used to help determine the best treatment method (distillation or perhaps electorefining) for plenums.

To help alleviate storage constraints in the FCF argon cell, additional packaging configurations should be considered that would support relocation of the plenums for interim storage out of the cell.

6. REFERENCES


11. Code of Federal Regulations, Title 40, Chapter 1, Subchapter I, Part 261, Subpart A, Section 261.4(c) (July 2011).


