72-1027 TN-68 AMENDMENT 1
TABLE OF CONTENTS

SECTION **PAGE**

List of Tables

CHAPTER 14

DECOMMISSIONING

14.1 Decommissioning Considerations

The TN-68 cask design features inherent ease and simplicity of decommissioning. At the end of its service life cask, decommissioning could be performed by one of the options listed below:

- Option 1, the TN-68, including spent fuel in storage, could be shipped to either a monitored retrievable storage system (MRS) or a geological repository for final disposal, or

- Option 2, the spent fuel could be removed from the TN-68 cask (either at the utility or at another off site location) and shipped in a DOE approved cask.

The first option does not require any decommissioning of the TN-68 cask. No residual contamination is expected to be left behind on the concrete base pad. The base pad, fence, and periphery utility structures will require no decontamination or special handling after the last cask is removed. The ISFSI pad could be demolished with normal construction techniques.

The second option would require decontamination of the TN-68 cask. The sources of contamination in the interior of the cask would primarily be crud left from the spent fuel pool water or crud from the spent fuel pins. These are expected to be low levels of contamination which could simply be removed with high pressure water spray. After decontamination, the TN-68 cask could either be cut up for scrap or partially scrapped. Any metal activation would be shipped as low level radioactive waste to a near surface disposal facility. For surface decontamination of the TN-68, electropolishing or chemical etching can be used to remove the contaminated surface of the cask.

Cask activation analyses have been performed to quantify the specific activities of the cask materials after years of storage. The following assumptions were made:

- the cask contains 68 7x7 BWR fuel assemblies at 40 GWd/MTU and 10 years cooling, and
- the neutron flux is assumed constant for 40 years.

The activation calculation is performed with the 7x7 fuel source identified in Chapter 5 using the computer code ORIGEN2. The total neutron fluxes are taken from a radial SAS1 (one dimensional) shielding calculation performed with the XSDRN-PM code using source term and radial shielding thicknesses similar to those used for 7x7 fuel in Chapter 5. The SAS1 input file is provided in Section 14.2. The fluxes at the cask centerline, the cavity wall, the neutron shield, and the outer shell are used to irradiate the basket, the body, the lid, the neutron shield, and outer shell and protective cover. The fluxes, material compositions and masses of irradiated material are listed in Table 14.1-1. The ORIGEN2 cross section library for BWR's at a burnup of 27,500 MWD/MTU is used.

The results listed in Table 14.1-2 indicate that after 40 years irradiation and 30 days decay (to eliminate very short lived radionuclides), the total activity is less than 0.071 Ci.

To evaluate the TN-68 cask and basket for disposal, the specific activity of the isotopes listed in Tables 1 and 2 of 10 CFR 61.55 is determined and compared with the limits for Class A waste in those tables.

It is expected that after the application of a surface decontamination method, the radiation levels will be below the acceptable limits of Regulatory Guide 1.86.[1] The results of the calculation, shown in Table 14.1-3, show that activation of TN-68 will be far below the specific activity limits for both long and short lived nuclides for Class A waste. A detailed evaluation will be performed at the time of decommissioning to determine the appropriate mode of disposal.

The procedure for decommissioning the TN-68 is summarized below:

- Remove bolts, weather shield, overpressure monitoring system, top neutron shield (polyethylene disc), port covers, quick disconnect fittings, and seals. Evaluate surface contamination and determine if these items should be disposed of as non-radioactive waste or as low-level radioactive waste.

- Wash down the TN-68 basket inside the cask. Pump out and filter contaminated water and cleaning agent.

- Remove basket and rails and wash down again. Cut and crush basket for disposal as low level radioactive waste.

- Decontaminate the lid and basket rails until able to dispose of as scrap metal. If unable to achieve these levels, cut and dispose of as low level radioactive waste.

- Decontaminate the cask body. Cut the outer neutron shield shell and remove the neutron shield boxes. These are not expected to be contaminated; verify and dispose of as non-radioactive waste.

- Verify status of the cask body. It is expected that surface decontamination will be adequate, if so then dispose of the cask body as scrap metal. If unable to decontaminate to these levels, the cask body can be cut and disposed of as low level radioactive waste.

As stated earlier under option 1, due to the leak tight design of the storage casks, no residual contamination is expected to be left behind on the concrete base pad. No special techniques are necessary to remove the concrete pad.

The volume of waste material produced incidental to ISFSI decommissioning is expected to be limited to that necessary to accomplish surface decontamination of the casks if the spent fuel elements must be removed. Furthermore, it is estimated that the cask materials will be slightly activated as a result of their long term exposure to the relatively small neutron flux emanating from the spent fuel, and that the resultant activation level will be well below the allowable limits

for general release of the casks as noncontrolled material. Therefore, it is anticipated that the casks, may be decommissioned from nuclear service by surface decontamination alone, which could be performed at the utility.

A detailed decommissioning plan will be submitted prior to the commencement of decommissioning activities. The costs of decommissioning the ISFSI are expected to represent a small and negligible fraction of the cost of decommissioning a nuclear utility.

14.2 Supplemental Information

14.2.1 SAS1 Input File

```
=sas1
tn68-1d-rad, calc 972-07, GE 7x7, 40,000 MWD/MTU, 3.3wt%, 10 year
27N-18COUPLE   INFHOMMEDIUM
'Fuel-Basket Zone - without channel
uo2          1  den=1.885  1.0 293.  92235 3.3  92238 96.7 end
zircalloy     1  den=0.430  end
ss304         1  den=0.707  end
al           1  den=0.237  end
'Plenum-Basket Zone - without channel
zircalloy     2  den=0.359  end
ss304         2  den=0.614  end
al           2  den=0.185  end
'Top Fitting Zone - No Basket - without channel
zircalloy     3  den=0.182  end
ss304         3  den=0.309  end
'Bottom Fitting-Basket Zone - without channel
zircalloy     4  den=0.205  end
ss304         4  den=1.475  end
al           4  den=0.238  end
'Basket outer shell
ss304         5  1.0   end
'basket outer shell and shims and rails
al           6  1.0   end
'Cask Body, Outer Shell, Polydisc shells
carbonsteel   7  1.0   end
'Polypropylene disk
arbmpropylene 0.90  2  1  0  0  1001 14.3  6012 85.7 8 1.0 end
'Resin/Aluminum
arbmtnres    1.58  5  1  0  0  1001 5.05 5000 1.05 6012 35.13
8016  41.73  13027 14.93  9  0.904  end
al           9  0.096   end
end comp
end
last
tn68 gamma and neutron dose - 1 dimensionsal analysis - radial
cylindrical
1  50.0     75    -1   0.    0.   754.3  1.161E10
1  83.92    75    -1   0.    0.   754.3  1.161E10
5  84.4     1     0
6  88.27    6     0
7  107.32   27    0
9  122.56   19    0
7  124.47    3    0
end zone
0.01843  0.20989  0.23295  0.13102  0.17703  0.19296
0.03777  28z   0.00369  0.02404  0.02607  0.48033
0.04253  0.00998  0.01624  0.05803  0.07415  0.26490
0.01843  0.20989  0.23295  0.13102  0.17703  0.19296
0.03777  28z   0.00369  0.02404  0.02607  0.48033
0.04253  0.00998  0.01624  0.05803  0.07415  0.26490
read xsdose
365.76
end
```

14.3 References

1. Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors."

TABLE 14.1-1

DATA FOR TN68 ACTIVATION ANALYSIS

Component	Flux (n/cm^2/ s)	Composition	Element	% wt
Body & Lid	2.34E5	SA350LF3 and/or SA203	Mn	0.9
			Ni	3.75
			Fe	94.8
			C	0.2
			Si	0.35
Gamma Shield	2.34E5	SA105	Mn	1.0
			Fe	98.5
			C	0.2
			Si	0.3
Outer Shell	2.28E2	SA516 Gr 55	Mn	0.7
			Fe	99.3
Neutron Shield	4.63E3	Polyester Resin Mixture	H	5.05
			B	1.05
			C	35.13
			O	41.73
			Al	14.93
			Zn	2.11
Fuel Basket (poison assumed as Al)	4.91E5	SA240 (SS304)	Mn	2.0
			Cr	19.0
			Ni	9.5
			Si	0.75
			Fe	68.75
		SB-209 (Al 6061)	Si	0.6
			Mg	1.0
			Cr	0.2
			Cu	0.3
			Al	97.9

TABLE 14.1-2

RESULTS OF ORIGEN2 ACTIVATION ANALYSIS
Curies per Cask

Nuclide	Basket	Body, Lid and Rails	Resin and Al Boxes	Outer Shell & Protective Cover	Total
Cr^{51}	7.216E-3	6.625E-5	1.027E-7	5.660E-9	7.282E-03
Mn^{54}	6.527E-4	3.148E-3	-----	3.093E-7	3.801E-03
Fe^{55}	9.690E-3	4.640E-2	-----	4.557E-6	5.609E-02
Fe^{59}	1.789E-4	8.627E-4	-----	8.476E-8	1.042E-03
Co^{58}	8.856E-4	2.488E-4	-----	-----	1.134E-03
Co^{60}	1.235E-5	3.486E-6	4.636E-10	-----	1.584E-05
Ni^{63}	1.292E-3	3.630E-4	1.554E-09	-----	1.655E-03
Zn^{65}	-----	-----	6.926E-6	-----	6.926E-06
Ni^{59}	1.068E-5	3.001E-6	-----	-----	1.368E-05
H^{3}	-----	-----	1.618E-10	-----	1.618E-10
C^{14}	-----	2.066E-10	5.898E-10	-----	7.964E-10
TOTAL					7.104E-02

Note: Only the nuclides with activity greater than 10^{-10} curies and those listed in 10 CFR 61.55 are reported here.

TABLE 14.1-3

COMPARISON OF TN-68 ACTIVITY WITH CLASS A WASTE LIMITS

Specific Activity of Long-Lived Isotopes (10CFR61.55 Table 1)

Nuclide	Ci/m^3	Limit (Ci/m^3)	Volume (m^3)	Component
C^{14}	-----	80	1.72	Basket
Ni^{59}	6.21E-6	220		
C^{14}	3.24E-11	80	6.38	Body
Ni^{59}	1.67E-6	220		
C^{14}	1.33E-10	80	4.43	Resin

Specific Activity of Short-Lived Isotopes (10CFR61.55 Table 2)

Nuclide	Ci/m^3 "A"	Limit (Ci/m^3) "B"	Volume (m^3)	Component
Co^{60}	7.18E-6	700	1.72 m^3	Basket
Ni^{63}	7.51E-4	35		
$T_{1/2}<5$	1.08E-2*	700		
Co^{60}	5.46E-7	700	6.38 m^3	Body
Ni^{63}	5.69E-5	35		
$T_{1/2}<5$	7.95E-3*	700		
$T_{1/2}<5$	6.98E-6*	700	0.71 m^3	Shell
H^3	3.65E-11	40	4.43 m^3	Resin
Co^{60}	1.05E-10	700		
Ni^{63}	3.51E-10	35		
$T_{1/2}<5$	1.59E-6*	700		

* - Sum of isotopes with half-life less than 5 years (Cr^{51},Mn^{54},Fe^{55},Fe^{59},Co^{58},Zn^{65})