

## Validation of the German certificate of package approval of package NCS 45 no. D/4347/B(U)F-96 (Rev. 0)

NRC Ref.: Docket No. 71-3084, Model Nr. NCS-45 Package, German Package Design Certificate No. D/4347/B(U)F-96 Revision 0

Answers and comments to questions raised with e-mail from February 26, 2009

### 1.0 Materials Section Deficiencies

1.1 DWR Pressurized Water Reactor  
SWR Boiling Water Reactor

#### 1.2 Specification of structural materials in English notation

Material Test Sheet	Drawing No.	European specification	US specification	Reference
WPB-02-02	2-150-151-02-00	1.3964	UNS S20910	bar SA-479 forgings SA-182 seamless tube SA-213
WPB-05-07	1-150-151-01-01	1.4429	UNS S31653	forgings SA-182
WPB-05-15	1-150-151-01-07	1.4429	UNS S31653	forgings SA-336
	1-150-151-01-08	1.4429	UNS S31653	seamless tubes SA-213
WPB-05-10	1-150-151-01-01	1.4565	UNS S34565	code case 2146 covers forgings, bars, seamless tubes, plates
	4-150-151-01-04	1.4565	UNS S34565	
WPB-05-18	1-150-151-01-00	1.4571	UNS S31635	ISO 683/1321 plate SA-240, bars 316Ti
WPB-05-18	1-150-151-01-01	1.4305	UNS S30300	
WPB-05-07	1-150-151-02-01	1.4462	UNS S32205	ASTM 2205
WPB-02-03	150-151-00	Pb940R	UNS L50041	
WPB-05-18	0-150-151-05-00	AlMg3	UNS N06002	ISO 6361-2 (1990-2)
Chapter 4, P. 58 of 89		1.4541	UNS S32100	ASTM 321

#### 1.3 "Canned Fuels"

The cans for the fuel are specified in the drawings 2-190-108-00-01 and 2-190-112-00-01 enclosed in the set of drawings in attachment 3.1 of the SAR. Currently, only welded



cans are allowed. NCS is currently working on other solutions to provide adequate barrier functions which will be included in Rev. 1 of the certificate at a later stage.

1.4 See 1.2

#### 1.5. References for Material Properties

##### 1.5.1 AKSTEEL

A subsidiary of former Armco Inc., Middleton, Ohio, now merged with AKSTEEL  
Deliverer of Nitronic 50 and 50HS bars, UNS S20910 and Nitronic 60 bars, UNS S21800

See Attachment 1: Specification of Nitronic 50 and 50HS

See Attachment 2: Specification of Nitronic 60

##### 1.5.2 GURUSWAMY

"Engineering Properties and Applications of Lead Alloys", Sivaraman Guruswamy,  
University of Utah, Salt Lake City, Utah; ISBN 0-8247-8247-X

Page 59 Table 6 Listing of Lead Alloys as per the Unified Numbering System

Page 98 Table 21 Thermal Properties of Lead Alloys

Page 124 Table 24 Mechanical Properties of Lead Alloys

Page 132 Table 25 Mechanical Properties of Commonly Used Lead Alloys

Page 163 Figure 59 Creep-to-rupture Diagram of Lead and Lead Alloys

Diagrams see Attachment 3

##### 1.5.3 NIEMZ

"Physics of Wood and Wooden Materials"; ISBN 3-87181-324-9

Text and Diagrams see Attachment 4

##### 1.5.4 GGR009

Federal Agency for Material Research and Testing

"Guideline for Calculating Lid Systems and Load Attachment Systems for Radioactive  
Material Transport Casks", 8<sup>th</sup> Draft, March 2006

See Attachment 5

##### 1.5.5 Steel Standards

See Attachment 6

## 1.6 Scope of proof in sections 4.3.1, 4.4.1 and 4.5.1

In these sections the scope of proof with respect to other chapters of the SAR is specified. Generally, these sections 4.3.1 to 4.5.1 are the extract of the summary of the results of the analyses in the respective chapters 4.3 to 4.5 with respect to the required input data for the chapters in the SAR.

E. g., section 4.3.1.1 specifies as scope of the mechanical analysis with respect to thermal design that no change of properties and shape of the package occurs during routine conditions of transport which might affect the thermal design. Subsequently, in section 4.3.2 the safe design of the trunnions is proofed, it is proofed that the packaging body is not deformed by routine conditions of transport and the design of the interior components is analysed. These analyses together result in the summarized statement of section 4.3.1.1.

E. g., section 4.5.1.1 specifies a deformation of 60% of the shock absorbers after drop tests in axial directions, which is proofed in section 4.5.2.3, 4.5.2.4 and compared with drop test results in section 4.5.2.9 validating the theoretical analysis in the foresaid chapters.

## 1.7 Balsa Wood

These data are in Attachment 4.5: "Evaluation of static and dynamic tests with wood specimens" in Chapter 4, Page 4-184 et.sec.

## 1.8 Symbols of Strength of Materials

$R_{P0.2}$	Yield strength with 0.2% residual strain
$R_{P1.0}$	Yield strength with 1.0% residual strain (for austenitic steels)
$R_m$	Tensile strength

## 1.9 Parameter on Axis of Diagrams

Figure	Y axis	X axis
5 - 1	m	m
5 - 2	m	m
5 - 3	m	m
5 - 4	m	m
5 - 5	m	m
5 - 6	m	m
5 - 7	°C	s
5 - 8	m	m
5 - 9	m	m
5 - 10	°C	s
5 - 11	m	m
5 - 12	°C	s
5 - 13	°C	s
5 - 14	°C	s
5 - 15	m	m
5 - 16	°C	s
5 - 17	°C	s

### 1.10 Bolt Calculations

Bolt calculations for the trunnions are in German due to another Version of KISSsoft. Please compare the data with all other KISSsoft calculations in English.

See Attachment 7

## 2.0 Structural Section Deficiencies

For FEM-calculation for the trunnions see Attachment 8.

For FEM-calculation for drop angles see Attachment 9.

For KISSsoft-calculation for the trunnions see item 1.10

For the English title blocks of drawings see Attachment 10.

## 3.0 Criticality and Shielding Section Deficiencies

The unit of length used in the chapters containing the criticality and shielding analyses comply with the formulation of the SCALE program code which requires cm.

## 4.0 Thermal and Containment Section Deficiencies

The thermal analysis has been carried out with HEATING 7 which is used and validated since a long time. The simple shape of the package does not require the use of advanced capabilities of newer programs. Also, calculated temperatures remain well below the limit of the Regulations such providing adequate safety margins.

The calculation was checked by the German competent authority BAM by carrying out own calculations. In the design examination certificate No. III.3/20837 of BAM it is stated on page 69, first paragraph

Quote

Going beyond the applicant's calculations, BAM carried out their own analyses with the ANSYS 11 program and can thus confirm the reliability of HEATING 7 for the verifications which must be performed here, based on these analyses.

Unquote

Table 5-8 list the temperatures at the package without solar insolation. The temperature of the accessible surface is (cask surface bottom side) maximal 69°C which is far below the limit of 85°C specified in the regulations.

Generally, the package will be shipped in an ISO container in which case the allowable thermal power is reduced from 3000 W to 2500 W for the package (see certificate of package approval).