Contract Program or Title:	Embrittlement Data Base and Dosimetry Evaluation Program
Subject of this Document:	Review of the International Atomic Energy Agency International Database on Reactor Pressure Vessel Materials and U.S. Nuclear Regulatory Commission/Oak Ridge National Laboratory Embrittlement Data Base
Type of Document:	Letter Report
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Date of Document:	February 1998
Responsible NRC Individual and NRC Office or Division:	C. Fairbanks (301-415-6014) Division of Engineering , U.S. Nuclear Regulatory Commission

**Prepared for the
U.S. Nuclear Regulatory Commission
Washington, DC 20555
under Interagency Agreement DOE 1886-N616-4W
NRC JCN No. W6164**

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Oak Ridge, TN 37831-6370
managed by
LOCKHEED MARTIN ENERGY RESEARCH CORP.
for the
U.S. Department of Energy
under contract DE-AC05-96OR22464.**

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ORNL/NRC/LTR-97/25

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Manuscript Completed - November 1997
Date Published - February 1998

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ABSTRACT

The Division of Nuclear Power of the International Atomic Energy Agency (IAEA) in Vienna, Austria, has supported neutron radiation effects information exchange through consultants' meetings, specialists' meetings, and conferences since the mid-1960s. Later, through an International Working Group (IWG) on Reliability of Reactor Pressure Components, information exchange and research activities were actively fostered through the Coordinated Research Program (CRP) sponsored by the IAEA. The final CRP meeting was held in November 1993 in Vienna, where it was recommended that the IAEA should coordinate the development of an International Database on Reactor Pressure Vessel Material (IDRPVM) as the first step in generating an International Database on Aging Management.

The purpose of this study was to provide special technical assistance to the NRC in monitoring and evaluating the IAEA activities in developing the IAEA IDRPVM, and to compare the IDRPVM with the Nuclear Regulatory Commission (NRC) - Oak Ridge National Laboratory (ORNL) Power Reactor Embrittlement Data Base (PR-EDB) and provide recommendations for improving the PR-EDB. A first test version of the IDRPVM was distributed at the First Meeting of Liaison Officers to the IAEA IDRPVM, in November 1996. No power reactor surveillance data were included in this version; the testing data were mainly from CRP Phase III data. Therefore, because of insufficient data and a lack of power reactor surveillance data received from the IAEA IDRPVM, the comparison is made based only on the structure of the IDRPVM. In general, the IDRPVM and the EDB have very similar data structure and data format.

One anticipates that because the IDRPVM data will be collected from so many different sources, quality assurance of the data will be a difficult task. The consistency of experimental test results will be an important issue. A very wide spectrum of material characteristics of RPV steels and irradiation environments exists among the various countries. Hence the development of embrittlement prediction models will be a formidable task.

CONTENTS

ABSTRACT	iii
ACKNOWLEDGMENTS	vii
1. INTRODUCTION	1
2. USNRC/ORNL EDB AND THE IDRPVM	2
2.1 Comparison of Data Information	2
2.1.1 Material Identification	2
2.1.2 Aging History	2
2.1.3 Mechanical Testing	2
2.1.4 References	2
2.1.5 Nondestructive Testing	2
2.1.6 Collected Curves	3
2.1.7 Summary of Comparison	3
2.2 Comparison of Software	3
2.3 The Proposed Upgrade EDB Software	4
3. CONCLUSIONS	5
4. REFERENCES	6

FIGURES

Fig. 1. Structure of the IAEA IDRPVM Database	15
Fig. 2. Architecture of Embrittlement Data Base (EDB)	16

TABLES

Table 1. Chemical Composition of Testing Materials in CPR-3	7
Table 2. Baseline Materials' Transition Temperature in CRP-3	10
Table 3. Irradiated Materials' Transition Temperature in CRP-3	13
Table 4. Fit of the EDB in the Structure of the IDRPVM	17

ACKNOWLEDGMENTS

The authors gratefully acknowledge Rachel Whittenbarger for preparing this report, J.V. Pace III, I. Remec, and B. L. Kirk for their valuable suggestions in reviewing this report, J. V. Pace III for his guidance on this project, and Carolyn Fairbanks and Mike Mayfield of the U.S. Nuclear Regulatory Commission for their financial support.

1. INTRODUCTION

The Division of Nuclear Power of the International Atomic Energy Agency (IAEA) in Vienna, Austria, has supported neutron radiation effects information exchange through consultants' meetings, specialists' meetings, and conferences since the mid-1960s. Later, through an International Working Group (IWG) on Reliability of Reactor Pressure Components, information exchange and research activities were actively fostered through the Coordinated Research Program (CRP) sponsored by the IAEA.

The CRP consisted of three phases with the following objectives:

- Phase I (1971 to 1976) - to approve a standard program on the engineering aspects of irradiation embrittlement of reactor pressure vessel steels;
- Phase II (1976 to 1983) - to study a reference steel from the United States, forging and weld from France and Japan, and forging and weld materials from Germany; and
- Phase III (1983 to 1994) - to consolidate the data and knowledge of embrittlement and to establish guidelines for surveillance testing.

A database from the results of the CRP Phase III (CRP-3) program was documented and published by IAEA [1]. The results are presented in Tables 1-3, where 80% of the data are from research reactors and 20% from surveillance channels of power reactors.

The final CRP meeting was held in November 1993 in Vienna, where it was recommended that the IAEA should coordinate the development of an International Database on Reactor Pressure Vessel Material (IDRPVM) as the first step in generating an International Database on Aging Management. The IWG on Life Management of Nuclear Power Plants (LMNPP) proposed that the IDRPVM should contain the CRP database and both power and test reactor data. The objectives were the following:

- to integrate surveillance data gathering from IAEA member countries to assist reactor operators in accounting for the effects of neutron irradiation damage of vessel materials when characterizing the condition of reactor vessels;
- to establish guides for data collection, compilation, verification, maintenance, and documentation to ease the task of data retrieval and manipulation within a multinational database management system;
- to develop a multinational database of vessel material surveillance data using a standardized format for ease of data transfer and utilization; and
- to maintain the database and provide accessibility to IAEA partners for research activities.

The proposed scope of the International Database on Aging Management consists of the following databases:

- Reactor Pressure Vessel Materials;
- Primary Piping;
- Containment; and
- Steam Generators.

Database specifications for each of the databases is documented in Ref. 2, Appendices A, B, C, and D, respectively.

The purpose of this study was to provide special technical assistance to the NRC in monitoring and evaluating the IAEA activities in developing the IAEA IDRPVM, and to compare the IDRPVM with the Nuclear Regulatory Commission (NRC) – Oak Ridge National Laboratory (ORNL) Power Reactor Embrittlement Data Base (PR-EDB) and provide recommendations for improving the PR-EDB. A first test version of IDRPVM was distributed at the First Meeting of Liaison Officers to the IAEA IDRPVM in November 1996 [3]. No power reactor surveillance data were included in this version; the testing data were mainly from CRP-3 data.

In this report, database is written as both one and two words. When written as two words, it refers to the U.S. NRC - ORNL PR-EDB.

2. USNRC/ORNL EDB and the IDRPVM

The structures of the IDRPVM and EDB are shown in Figs. 1 and 2, respectively. Table 4 shows how the EDB would fit into the IDRPVM structure. Not all the group data would be mandatory. Group data (material identification, aging history, material testing, and reference data) are requested, and nondestructive testing and collected curves were added as additional information that could be valuable to researchers.

2.1 Comparison of Data Information

Because of the insufficient data received from the IAEA IDRPVM, the comparison that follows is made based only on the structure of the IDRPVM.

2.1.1 Material Identification

The EDB and IDRPVM are essentially identical except that IDRPVM does not contain a heat identification file for HAZ data. Three data fields,—WELD_TYPER, WIRE_TYPER, and WIRE_HEATER—are not in the EDB, as these data were not given in U.S. surveillance reports.

2.1.2 Aging History

The two databases are equivalent in data content.

2.1.3 Mechanical Testing

The formats of the IDRPVM are almost identical to the EDB. The parameters of exponential fit for fracture toughness data are not currently in the EDB, but can be easily incorporated in future versions.

2.1.4 References

Reference data in both databases are equivalent.

2.1.5 Nondestructive Testing

Currently, only ultrasonic test data are proposed for the EDB, but other nondestructive testing techniques could be implemented with little difficulty, depending on NRC needs.

2.1.6 Collected Curves

Graphical data, such as instrumented Charpy test data, static fracture test data, flux distribution, and spectra data are being considered for the EDB.

2.1.7 Summary of Data Comparison

The IDRPVM and the EDB have very similar data structure. However, the drop weight test data, initial RT_{NDT} , and RPV geometry, are not contained in the IDRPVM database. These three items are needed for the determination of the pressure-temperature limits of operating reactors. Figure 2 shows the architecture of the EDB that includes both existing files and proposed files.

One anticipates that because the data are collected from so many different sources, quality assurance of the data will be a difficult task. The consistency of experimental test results will be an important issue. A very wide spectrum of material characteristics of RPV steels and irradiation environments exists among the various countries. Hence the development of embrittlement prediction models will be a formidable task.

Finally, one should note that eight countries were present at the First Meeting of Liaison Officers [3] to the IAEA IDRPVM. The United States did not receive an invitation because of an oversight at IAEA. The proposed inputs from the eight countries are given in Ref. 3, and a summary of the data already in the EDB was given to NRC (Carolyn Fairbanks). Based on the timetable for the receipt of data from the eight countries, the first release of the IDRPVM by IAEA should be available November-December 1997. The next Liaison Officers' Meeting is scheduled in February 1998.

2.2 Comparison of Database Software

A test version of the IDRPVM software was distributed at the First Meeting of Liaison Officers, November 14-15, 1996, London, United Kingdom. The software was developed using Microsoft (MS) Access. This first version only allows the users to select data, view or print data, and export data in MS Access formats. Users are expected to develop their own code to process and analyze the data.

The EDB on the other hand is a multifunction database management program that can retrieve, print, export data, process data, plot data, and fit data. This code was developed before the release of MS Windows. Currently, the EDB is designed for use with any personal computer using the DOS operating system. The data format that was chosen for the EDB is dBASE (also adopted by IAEA). This format allows queries and data processing not only with the current dBASE software but also with any of the numerous "Xbase" developers' tools, such as Clipper or Foxpro. The dBASE files can also be imported into most other databases, spreadsheets, and word-processing programs that run in the DOS or WINDOWS environment. The more recent versions of these programs contain extensive utilities for generating reports, including statistical,

curve fitting, and graphic programs. For often-performed tasks, a customized EDB Utility program was written based on Clipper and FORTRAN. This EDB Utility is menu-driven and requires little or no training.

The data in the EDB are taken directly from the quoted documents (surveillance reports) without any interpretation or evaluation. All numerical values are given in the units of the original documents. If several determinations of chemistry are reported for the same material, it is left to the user to select or, perhaps, average the different values. Evaluation, selection, and unit conversion will be necessary whenever these data are to be used for investigations and analysis of reactor safety issues. The creation of evaluated data files is an integrated part of the EDB program development. The software "Process Raw dBASE Files" was created for the purpose of generating a one-to-one correspondence between the key identifiers and its related information.

Many tasks, such as "to streamline the raw data and to investigate what-if scenarios," can be programmed and handled much easier in the Windows environment than in DOS. Therefore, conversion of the EDB utility from DOS into Windows platform is an essential part of upgrading the EDB. The development in "Visual Object-Oriented Analysis and Design" in recent years provides a very powerful tool to generate a truly "user-friendly" software for database management. Using this tool to upgrade the EDB utility will speed up program development.

2.3 The Proposed Upgrade EDB Software

The proposed future EDB software has the following characteristics [4]:

- Operating under Windows environments;
- Retrieving, linking, and streamlining raw data to generate processed data files;
- Developing special routines to incorporate "what-if scenarios" into data-selection procedures and analysis;
- Built-in routines to automate the procedures for updating analysis, for follow-up studies, and updating reports.

The details for the update data structures and data acquisitions sheets of the future EDB data input are stated in Ref. 4.

3. CONCLUSIONS

A first test version of IDRPVM was distributed at the First Meeting of Liaison Officers to the IAEA IDRPVM, on November 1996. No power reactor surveillance data were included in this version, and the testing data were mainly from CRP-3 data. Because of the insufficient data and lack of power reactor surveillance data received from the IAEA IDRPVM, the comparison was made based only on the structure of the IDRPVM. The more-detailed data comparison will be made upon receiving the update IDRPVM. In general, the IDRPVM and the EDB have very similar data structure and data format. The IDRPVM software was developed using MS Access and is operating in Windows environment. The first version of IDRPVM only allows the users to select data, view or print data, and export data in MS Access format. The EDB on the other hand is a multifunction database management program that can retrieve, print, export data, process data, plot data, and fit data. Currently, EDB is operating in a DOS environment.

One anticipates that because the IDRPVM data will be collected from so many different sources, quality assurance of the data will be a difficult task. The consistency of experimental test results will be an important issue. A very wide spectrum of material characteristics of RPV steels and irradiation environments exists among the various countries. Hence, the development of embrittlement prediction models will be a formidable task.

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- [3] V. Lyssakov, "The Minutes of the First Meeting of Liaison Officers to the IAEA International Database on Reactor Pressure Vessel Materials, 14-15 November 1996, AEA Technologies Headquarters, London, United Kingdom," May 14, 1997.
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Table 1. Chemical Composition of Testing Materials in CRP-3 (in wt%)

MATCODE	BLOCK	DEPTH	C	SI	MN	P	S	MO	NI	CR	CU	V	CO	AL	OTHERS	INSTITUT	COUNTRY	NO
15H2MFA			0.16	0.20	0.66	0.006	0.0230	0.81	0.05	2.78	0.040	0.340	0.011	0.128	N=0.010	ZKF Rossendorf	GDR	ZFW-1
15H2MFA			0.16	0.16	0.47	0.007	0.0180	0.74	0.03	2.60	0.350	0.310	0.011	0.097	N=0.040	ZKF Rossendorf	GDR	ZFW-2
15H2MFA			0.15	0.12	0.28	0.018	0.0280	0.70	0.07	2.35	0.140	0.230	0.011	0.025	N=0.017	ZKF Rossendorf	GDR	ESW-A
15H2MFA			0.18	0.14	0.29	0.046	0.0300	0.68	0.07	2.61	0.140	0.350	0.011	0.009	N=0.014	ZKF Rossendorf	GDR	ESW-B
15H2MFA			0.15	0.18	0.36	0.018	0.0300	0.67	0.07	2.60	0.340	0.300	0.010	0.007	N=0.018	ZKF Rossendorf	GDR	ESW-C
15H2MFA			0.15	0.25	0.42	0.042	0.0300	0.68	0.07	2.65	0.320	0.290	0.010	0.009	N=0.034	ZKF Rossendorf	GDR	ESW-D
15H2MFA			0.16	0.29	0.48	0.009	0.0120	0.67	0.18	2.85	0.090	0.280	0.000	0.000		ZKF Rossendorf	GDR	AM
15H2MFA			0.14	0.23	0.52	0.011	0.0130	0.60	0.23	2.62	0.230	0.280	0.020	0.010		ZKF Rossendorf	GDR	KAB-B
15H2MFA			0.17	0.24	0.52	0.011	0.0120	0.64	0.25	2.59	0.210	0.260	0.000	0.000		ZKF Rossendorf	GDR	RH-A
15H2MFA			0.13	0.36	0.47	0.012	0.0140	0.74	0.19	2.35	0.150	0.300	0.000	0.000	As=0.010	ZKF Rossendorf	GDR	RH-B
15H2MFA			0.16	0.29	0.54	0.014	0.0180	0.68	0.07	2.70	0.090	0.280	0.010	0.000	As=0.010	ZKF Rossendorf	GDR	PA1-B
15H2MFA			0.05	0.39	1.32	0.050	0.0140	0.24	0.19	1.29	0.190	0.170	0.017	0.015		ZKF Rossendorf	GDR	KAB-W
15H2MFA			0.05	0.37	0.90	0.010	0.0160	0.65	0.18	1.40	0.180	0.220	0.000	0.000	As=0.015	ZKF Rossendorf	GDR	RH-W
15H2MFA			0.04	0.64	1.25	0.014	0.0130	0.50	0.06	1.34	0.080	0.210	0.008	0.000		ZKF Rossendorf	GDR	PA1-W
BW			0.06	0.55	1.33	0.012	0.0090	0.37	1.58	0.06	0.220	0.020	0.000	0.020	N=0.0005	AEARS, HARWELL	UK	
BW						0.007			1.59		0.230				N=0.00016	AEARS, HARWELL	UK	001
D4S			0.07	0.00	1.57			0.48	0.78	0.14	0.050	0.004	0.011			CEN CSK	B	
Fe-Cu			0.00	0.00	0.00	0.005	0.0020	0.01	0.03	0.02	0.310	0.010	0.004	0.000		ZKF Rossendorf	GDR	
FFA			0.17	0.20	1.30	0.006	0.0040	0.47	0.71	0.00	0.060	0.000	0.000	0.010		CEA	F	227
GFB		1/4t	0.21	0.20	0.86	0.006	0.0040	0.57	0.85	0.40	0.050	0.000	0.000	0.000		GKSS	FRG	
GWA		1/4t	0.08	0.17	1.45	0.013	0.0070	0.61	0.93	0.02	0.035	0.000	0.000	0.000		GKSS	FRG	
JF		60	0.17	0.20	1.27	0.016	0.0010	0.50	0.60	0.10	0.040	0.000	0.000	0.000		Com.Nac.E.Atom	Arg	
JF		0	0.19	0.27	1.36	0.007	0.0050	0.51	0.77	0.12	0.040	0.010	0.008	0.022	Ta=max0.005,V=ma	Muroran Plant	J	AT1
JF		0	0.18	0.26	1.33	0.007	0.0050	0.49	0.76	0.11	0.040	0.010	0.008	0.021	Ta=max0.005,V=ma	Muroran Plant	J	BT1
JF		0	0.18	0.27	1.35	0.008	0.0050	0.51	0.76	0.12	0.040	0.010	0.008	0.021	Ta=max0.005,V=ma	Muroran Plant	J	CT1
JF		0	0.18	0.27	1.35	0.007	0.0050	0.51	0.76	0.12	0.040	0.010	0.008	0.023	Ta=max0.005,V=ma	Muroran Plant	J	DT1
JF		0	0.18	0.26	1.34	0.007	0.0050	0.49	0.76	0.11	0.040	0.010	0.008	0.023	Ta=max0.005,V=ma	Muroran Plant	J	ET1
JF		0	0.18	0.26	1.31	0.007	0.0050	0.48	0.74	0.11	0.030	0.010	0.008	0.026	Ta=max0.005,V=ma	Muroran Plant	J	FT1
JFL		60	0.17	0.18	1.33	0.012	0.0010	0.50	0.70	0.10	0.010	0.000	0.000	0.000		Com.Nac.E.Atom	Arg	
JFL			0.17	0.25	1.42	0.004	0.0020	0.52	0.75	0.16	0.010	0.004	0.000	0.014	N=0.010	ZKF Rossendorf	GDR	
JFL		20	0.16	0.70	1.43	0.007	0.0070	0.51	0.74	0.16	0.020	0.010	0.000	0.030		KFKI	H	
JFL	BOTTOM	0/4t	0.17	0.25	1.40	0.004	0.0019	0.52	0.74	0.15	0.010	0.004	0.000	0.014	N=0.0091,O=0.001	Kawasaki Steel	J	
JFL	BOTTOM	1/4t	0.17	0.25	1.42	0.003	0.0017	0.52	0.75	0.16	0.010	0.004	0.000	0.014	N=0.0103,O=0.001	Kawasaki Steel	J	
JFL	BOTTOM	2/4t	0.15	0.25	1.36	0.005	0.0014	0.49	0.72	0.15	0.010	0.004	0.000	0.014	N=0.0093,O=0.003	Kawasaki Steel	J	
JFL	BOTTOM	3/4t	0.15	0.25	1.36	0.005	0.0014	0.49	0.72	0.15	0.010	0.004	0.000	0.014	N=0.0090,O=0.003	Kawasaki Steel	J	
JFL	BOTTOM	4/4t	0.16	0.25	1.39	0.004	0.0016	0.51	0.72	0.15	0.010	0.004	0.000	0.014	N=0.0095,O=0.003	Kawasaki Steel	J	
JFL			0.17	0.25	1.44	0.004	0.0020	0.51	0.75	0.20	0.010	0.004	0.000	0.016		JAERI	J	

Table 1. (continued)

MATCODE	BLOCK	DEPTH	C	SI	MN	P	S	MO	NI	CR	CU	V	CO	AL	OTHERS	INSTITUT	COUNTRY	NO
JFL			0.17	0.25	1.44	0.004	0.0020	0.51	0.75	0.20	0.010	0.000	0.000	0.016	N=0.0001	AEARS,HARWELL	UK	
JFL						0.004			0.72		0.010				N=0.00007	AEARS,HARWELL	UK	101
JFM	Coupon	0	0.18	0.25	1.42	0.014	0.0030	0.50	0.79	0.25	0.150	0.010	0.000	0.000	V=max!	Muroran Plant	J	
JFM			0.18	0.25	1.40	0.013	0.0030	0.49	0.77	0.25	0.160	0.010	0.000	0.000		Muroran Plant	J	
JPA			0.18	0.27	1.47	0.018	0.0020	0.54	0.82	0.15	0.330	0.010	0.000	0.018		ZKF Rossendorf	GDR	
JPA						0.018			0.80		0.300				N=0.00006	AEARS,HARWELL	UK	006
JPB			0.00	0.00	0.00	0.017	0.0000	0.00	0.83	0.00	0.010	0.000	0.000	0.000		CEA	F	211
JPB			0.18	0.26	1.42	0.017	0.0010	0.54	0.83	0.15	0.010	0.010	0.000	0.016		ZKF Rossendorf	GDR	
JPB			0.18	0.26	1.42	0.017	0.0010	0.54	0.83	0.15	0.010	0.010	0.000	0.016		AEARS,HARWELL	UK	
JPB						0.017			0.78		0.010				N=0.00005	AEARS,HARWELL	UK	027
JPC			0.00	0.00	0.00	0.007	0.0000	0.00	0.81	0.00	0.010	0.000	0.000	0.000		CEA	F	212
JPC			0.18	0.27	1.45	0.007	0.0020	0.54	0.81	0.15	0.010	0.010	0.000	0.021		ZKF Rossendorf	GDR	
JPC			0.18	0.27	1.45	0.007	0.0020	0.54	0.81	0.15	0.010	0.010	0.000	0.021		AEARS,HARWELL	UK	
JPC						0.007			0.78		0.030				N=0.00029	AEARS,HARWELL	UK	027
JPD			0.19	0.27	1.45	0.006	0.0010	0.55	0.10	0.15	0.160	0.010	0.000	0.019		JAERI	J	
JPD						0.006			0.10		0.140				N=0.00002	AEARS,HARWELL	UK	002
JPE						0.006			0.40		0.150				N=0.00015	AEARS,HARWELL	UK	002
JPF			0.18	0.24	1.42	0.019	0.0020	0.54	0.57	0.15	0.150	0.020	0.000	0.012		ENSA	E	
JPF			0.18	0.25	1.49	0.020	0.0010	0.55	0.62	0.15	0.160	0.010	0.000	0.000		ENDESA et al.	E	
JPF			0.18	0.27	1.49	0.020	0.0010	0.55	0.62	0.15	0.160	0.010	0.000	0.010		JAERI	J	
JPF						0.020			0.59		0.140				N=0.00009	AEARS,HARWELL	UK	003
JPG			0.00	0.00	0.00	0.017	0.0000	0.00	0.82	0.00	0.150	0.000	0.000	0.000		CEA	F	213
JPG			0.18	0.27	1.45	0.017	0.0010	0.55	0.82	0.15	0.160	0.010	0.000	0.013		AEARS,HARWELL	UK	
JPG						0.017			0.79		0.160				N=0.00006	AEARS,HARWELL	UK	027
JPH			0.18	0.27	1.45	0.006	0.0010	0.54	1.18	0.15	0.170	0.010	0.000	0.021		JAERI	J	
JPH						0.006			1.17		0.150				N=0.00002	AEARS,HARWELL	UK	002
JPI		60	0.16	0.12	1.37	0.012	0.0010	0.60	0.60	0.10	0.010	0.000	0.000	0.000		Com.Nac.E.Atom	Arg	
JPI			0.18	0.21	1.50	0.006	0.0010	0.57	0.69	0.17	0.010	0.001	0.000	0.012		Nippon Steel	J	
JPI			0.18	0.21	1.50	0.006	0.0010	0.57	0.69	0.17	0.010	0.001	0.000	0.012		JAERI	J	
JPJ			0.18	0.23	1.44	0.009	0.0020	0.47	0.62	0.10	0.050	0.020	0.000	0.013		ENSA	E	
JPJ			0.18	0.23	1.43	0.004	0.0020	0.48	0.63	0.00	0.050	0.003	0.000	0.000		ENDESA et al.	E	
JPJ		1/4t	0.18	0.21	1.41	0.005	0.0010	0.50	0.64	0.10	0.050	0.000	0.000	0.000		GKSS	FRG	
JPJ			0.18	0.21	1.41	0.005	0.0010	0.50	0.64	0.10	0.050	0.003	0.000	0.000		JAERI	J	
JRQ		60	0.18	0.17	1.33	0.021	0.0010	0.50	0.60	0.10	0.180	0.000	0.000	0.000		Com.Nac.E.Atom	Arg	
JRQ		112	0.18	0.24	1.37	0.020	0.0000	0.50	0.82	0.13	0.140	0.002	0.000	0.016	As<0.005	CEN/SCK	B	
JRQ			0.18	0.25	1.41	0.018	0.0400	0.50	0.84	0.12	0.140	0.003	0.000	0.000		ENDESA et al.	E	
JRQ			0.18	0.25	1.38	0.018	0.0040	0.49	0.82	0.12	0.150	0.020	0.000	0.012		ENSA	E	

Table 1. (continued)

MATCODE	BLOCK	DEPTH	C	SI	MN	P	S	MO	NI	CR	CU	V	CO	AL	OTHERS	INSTITUT	COUNTRY	NO
JRQ			0.19	0.25	1.38	0.019	0.0040	0.49	0.83	0.00	0.140	0.000	0.000	0.012		CEA	F	226
JRQ		1/4t	0.19	0.25	1.41	0.019	0.0040	0.50	0.84	0.12	0.140	0.000	0.000	0.000		GKSS	FRG	
JRQ			0.19	0.25	1.41	0.019	0.0040	0.50	0.84	0.12	0.140	0.003	0.000	0.012		ZKF Rossendorf	GDR	
JRQ	Plate A	1/4t	0.19	0.25	1.41	0.019	0.0040	0.50	0.84	0.12	0.140	0.003	0.000	0.012		Kawasaki Steel	J	
JRQ	Plate A	2/4t	0.20	0.26	1.43	0.019	0.0040	0.51	0.85	0.12	0.140	0.003	0.000	0.012		Kawasaki Steel	J	
JRQ	Plate A	1/4t	0.18	0.25	1.39	0.017	0.0030	0.50	0.83	0.12	0.140	0.003	0.000	0.012		Kawasaki Steel	J	
JRQ	Plate A	2/4t	0.18	0.25	1.38	0.019	0.0040	0.49	0.82	0.12	0.140	0.003	0.000	0.012		Kawasaki Steel	J	
JRQ	Plate B	1/4t	0.19	0.25	1.39	0.019	0.0040	0.50	0.83	0.12	0.140	0.003	0.000	0.012		Kawasaki Steel	J	
JRQ	Plate B	2/4t	0.20	0.25	1.41	0.019	0.0040	0.50	0.84	0.12	0.140	0.003	0.000	0.012		Kawasaki Steel	J	
JRQ	Plate B	1/4t	0.18	0.25	1.37	0.018	0.0040	0.49	0.82	0.12	0.130	0.003	0.000	0.012		Kawasaki Steel	J	
JRQ	Plate B	2/4t	0.16	0.25	1.35	0.019	0.0030	0.49	0.80	0.12	0.130	0.003	0.000	0.012		Kawasaki Steel	J	
JRQ			0.18	0.24	1.42	0.017	0.0040	0.51	0.84	0.12	0.140	0.002	0.000	0.014		JAERI	J	
JRQ			0.18	0.24	1.42	0.017	0.0040	0.51	0.84	0.12	0.140	0.002	0.000	0.014		NRL-Risley	UK	
JRQ						0.017			0.82		0.140				N=0.00002	AEARS, HARWELL	UK	041
JWN			0.10	0.30	1.25	0.008	0.0030	0.48	0.87	0.03	0.020	0.002	0.000	0.008		Kobe Steel	J	
JWN			0.10	0.28	1.33	0.006	0.0040	0.47	0.87	0.04	0.018	0.002	0.000	0.016		Yokohama Res.l	J	
JWO		1/4t	0.07	0.29	1.24	0.005	0.0050	0.37	0.78	0.06	0.030	0.005	0.000	0.005		Tagasago Techn	J	
JWO(JWP)			0.07	0.28	1.08	0.006	0.0050	0.38	0.97	0.06	0.030	0.002	0.000	0.002		Kobe Steel	J	
JWP		1/4t	0.09	0.33	1.18	0.009	0.0040	0.40	0.90	0.06	0.030	0.002	0.000	0.010		Kure Works	J	
JWQ			0.09	0.30	1.29	0.026	0.0050	0.48	1.10	0.04	0.260	0.002	0.000	0.011		ZKF Rossendorf	GDR	
JWQ		20	0.18	0.23	1.42	0.017	0.0090	0.51	0.84	0.13	0.150	0.010	0.000	0.020		KFKI	H	
JWQ			0.09	0.29	1.23	0.018	0.0050	0.48	0.99	0.03	0.210	0.002	0.000	0.008		Kobe Steel	J	
JWQ		1/4t	0.09	0.30	1.29	0.026	0.0050	0.48	1.10	0.04	0.260	0.002	0.000	0.011		Kure Works	J	

Table 2. Baseline Materials' Transition Temperatures^a in CRP-3

MATERIAL	CODE	BLOCK	DEPTH	LAYER	ORIENT	HEATTREATM	T68	T41	T28	T09	FATT	USE ^b	ENGINEER	INSTITUTE	REMARK
FFA	SF11			diff.	L-T		-47.0	-57.0	-64.0	-52.0	-38.0	204.0	Wallin et al	VTT & IVO	
JF	Arg3		65		C-L		-45.0	-74.0	0.0	-38.0	0.0	268.0		C.N.E.A.	According to ASTM E-23
JFL	Arg3		65		C-L		-65.0	-87.0	0.0	-65.0	0.0	241.0		C.N.E.A.	According to ASTM E-23
JFL	CS1	51	55		C-L	no	-55.0	-71.0	0.0	-57.0	0.0	222.0	Brumovsky	Skoda	
JFL	GDR4	0	1/4	D	LT		-40.0	-54.0	-62.0	-46.0	-21.0	211.0	Popp et al.	Rosendorf	
JFL	GDR4	0	1/2	I	LT		-39.0	-52.0	-62.0	-46.0	-18.0	217.0	Popp et al.	Rosendorf	
JFL	J3 & J6				T-L		-72.5	-92.3	0.0	-81.3	-24.8	225.3	Ueda et al.	JAERI	
JFL	SF11			diff.	L-T		-33.0	-48.0	-57.0	-38.0	-18.0	210.0	Wallin et al	VTT & IVO	
JPA	FRG3	JPA2			T-L	no	-49.5	-71.6	0.0	-50.8	-19.0	199.0	Schmitt & al	GKSS	
JPA	GDR4	0					-54.0	-70.0	-82.0	-56.0	-29.0	200.0	Popp et al.	Rosendorf	lab.heat
JPA	J0						-54.0	-60.0	0.0	-50.0	-35.0	239.0		Nippon Steel	
JPB	FRG3	JPB3			T-L	no	-63.1	-78.5	0.0	-64.4	-37.9	202.2	Schmitt & al	GKSS	
JPB	GDR4	0					-53.0	-66.0	-75.0	-57.0	-31.0	205.0	Popp et al.	Rosendorf	lab.heat
JPB	J0						-50.0	-55.0	0.0	-52.0	-30.0	262.0		Nippon Steel	
JPC	FRG3	JPC3			T-L	no	-44.4	-55.5	0.0	-44.3	-30.1	199.9	Schmitt & al	GKSS	
JPC	GDR4	0					-40.0	-51.0	-59.0	-35.0	-24.0	202.0	Popp et al.	Rosendorf	lab.heat
JPC	J0						-48.0	-55.0	0.0	-50.0	-26.0	225.0		Nippon Steel	
JPD	FRG3	JPD6			T-L	no	-49.5	-62.3	0.0	-51.3	-28.2	199.4	Schmitt & al	GKSS	
JPD	Ind2						-59.0	-67.0	0.0	-60.0	-32.0	310.0	Chatterjee	Bhabha A.R.C	
JPD	Ind3		1/4		LT		-49.5	-66.1	0.0	-35.9	-29.7	0.0	Chatterjee	Bhabha A.R.C	Differs from Ind2,Tb2
JPD	J0						-51.0	-57.0	0.0	-50.0	-34.0	252.0		Nippon Steel	
JPD	J3 & J6				T-L		-78.6	-92.8	0.0	-81.1	-24.9	234.0	Ueda et al.	JAERI	
JPE	FRG3	JPE6			T-L	no	-51.4	-61.4	0.0	-51.1	-34.3	211.6	Schmitt & al	GKSS	
JPE	Ind2						-52.0	-63.0	0.0	-55.0	-30.0	305.0	Chatterjee	Bhabha A.R.C	
JPE	Ind3		1/4 ?		LT ?		-54.5	-62.1	0.0	-55.9	-30.4	0.0	Chatterjee	Bhabha A.R.C	Differs from Ind2,Tb2
JPE	J0						-54.0	-64.0	0.0	-53.0	-34.0	262.0		Nippon Steel	
JPF	E6						-44.1	-59.0	0.0	-45.1	0.0	0.0	Lapena et al		
JPF	FRG3	JPF6			T-L	no	-55.4	-70.3	0.0	-57.2	-26.1	201.1	Schmitt & al	GKSS	
JPF	Ind2						-58.0	-61.0	0.0	-58.0	-43.0	232.0	Chatterjee	Bhabha A.R.C	
JPF	Ind3		1/4 ?		LT ?		-52.3	-57.5	0.0	-61.2	-33.6	0.0	Chatterjee	Bhabha A.R.C	Differs from Ind2,Tb2
JPF	J0						-51.0	-59.0	0.0	-50.0	-28.0	236.0		Nippon Steel	
JPF	J3 & J6		1/4		T-L		-81.4	-101.7	0.0	-87.1	-41.4	231.4	Ueda et al.	JAERI	
JPG	FRG3	JPG7			T-L	no	-51.1	-62.4	0.0	-52.1	-30.4	213.8	Schmitt & al	GKSS	
JPG	Ind2						-71.0	-75.0	0.0	-72.0	-55.0	300.0	Chatterjee	Bhabha A.R.C	
JPG	Ind3		1/4 ?		LT ?		-67.4	-77.2	0.0	-72.9	-44.5	0.0	Chatterjee	Bhabha A.R.C	Differs from Ind2,Tb2
JPG	J0						-50.0	-56.0	0.0	-52.0	-31.0	242.0		Nippon Steel	
JPH	FRG3	JPH3			T-L	no	-64.0	-79.8	0.0	-60.5	-34.5	211.2	Schmitt & al	GKSS	

Table 2. (continued)

MATERIAL	CODE	BLOCK	DEPTH	LAYER	ORIENT	HEATTREATM	T68	T41	T28	T09	FATT	USE ^b	ENGINEER	INSTITUTE	REMARK
JPH	Ind2						-70.0	-72.0	0.0	-70.0	-48.0	278.0	Chatterjee	Bhabha A.R.C	
JPH	Ind3		1/4 ?		LT ?		-67.4	-74.5	0.0	-73.6	-48.4	0.0	Chatterjee	Bhabha A.R.C	Differs from Ind2, Tb2
JPH	J0						-43.0	-56.0	0.0	-44.0	-23.0	242.0		Nippon Steel	
JPH	J3 & J6				T-L		-79.9	-96.9	0.0	-84.0	-40.2	252.3		JAERI	
JPI	Arg3	6-7			C-L		-66.0	-89.0	0.0	-65.0	0.0	218.0		C.N.E.A.	According to ASTM E-23
JPI	J0		1/4		T		-68.0	-77.0	0.0	-64.0	-43.0	204.0		Nippon Steel	
JPI	J0		2/4		T		-45.0	-58.0	0.0	-64.0	-38.0	196.0		Nippon Steel	
JPI	J3 & J6		1/4		T-L		-86.6	-100.6	0.0	-90.4	-43.0	207.0	Ueda et al.	JAERI	
JPJ	E6						-3.3	-19.6	0.0	-11.5	0.0	0.0	Lapena et al		
JPJ	J3 & J6		1/4		T-L		-23.9	-36.6	0.0	-25.1	-2.4	233.2	Ueda et al.	JAERI	
JRQ	Arg3		65		T-L		-62.0	-84.0	0.0	-56.0	0.0	194.0		C.N.E.A.	According to ASTM E-23
JRQ	CH7	65	55		T-L		-11.0	-23.0	0.0	0.0	0.0	199.0		PSI	
JRQ	CS1	62	35		T-L	no	-17.0	-33.0	0.0	-20.0	0.0	224.0	Brumovsky	Skoda	
JRQ	CS3	64	55		T-L	no	-2.0	-15.0	0.0	-9.0	0.0	238.0	M.Brumowsky	UJV Rez	
JRQ	E6						7.2	-7.5	0.0	-29.0	0.0	0.0	Lapena et al		
JRQ	E6					291C/301ds	0.0	-23.0	0.0	-15.9	0.0	0.0	Lapena et al		
JRQ	FRG3	JRQ1			T-L	no	2.4	-11.1	0.0	-3.0	18.2	191.1	Schmitt & al	GKSS	
JRQ	GDR4	0	1/4	D	TL		-7.0	-21.0	-30.0	-16.0	13.0	193.0	Popp et al.	Rosendorf	
JRQ	GDR4	0	1/2	G	TL		1.0	-5.0	-11.0	-6.0	10.0	190.0	Popp et al.	Rosendorf	
JRQ	H3	31	diff.	more	T ?		-5.0	-10.0	0.0	-8.0	0.0	115.0	Gillemot	KFKI	
JRQ	J0	PL.A	0/4		L		-112.0	-115.0	0.0	0.0	-99.0	0.0		Kawasaki St.	At -12 C° 240 J
JRQ	J0	PL.A	1/4		L		-15.0	-28.0	0.0	0.0	2.0	0.0		Kawasaki St.	At -12 C° 75 J
JRQ	J0	PL.A	2/4		L		-13.0	-23.0	0.0	0.0	5.0	0.0		Kawasaki St.	At -12 C° 74 J
JRQ	J0	PL.B	0/4		L		-97.0	-115.0	0.0	0.0	-83.0	0.0		Kawasaki St.	At -12 C° 221 J
JRQ	J0	PL.B	1/4		L		-21.0	-28.0	0.0	0.0	2.0	0.0		Kawasaki St.	At -12 C° 87 J
JRQ	J0	PL.B	2/4		L		-4.0	-14.0	0.0	0.0	7.0	0.0		Kawasaki St.	At -12 C° 76 J
JRQ	J0	PL.A	0/4		T		-46.0	-53.0	0.0	0.0	-36.0	0.0		Kawasaki St.	At -12 C° 176 J
JRQ	J0	PL.A	1/4		T		-13.0	-23.0	0.0	0.0	2.0	0.0		Kawasaki St.	At -12 C° 69 J
JRQ	J0	PL.A	2/4		T		-8.0	-19.0	0.0	0.0	8.0	0.0		Kawasaki St.	At -12 C° 60 J
JRQ	J0	PL.B	0/4		T		-79.0	-110.0	0.0	0.0	-61.0	0.0		Kawasaki St.	At -12 C° 171 J
JRQ	J0	PL.B	1/4		T		-17.0	-24.0	0.0	0.0	4.0	0.0		Kawasaki St.	At -12 C° 80 J
JRQ	J0	PL.B	2/4		T		-3.0	-9.0	0.0	0.0	10.0	0.0		Kawasaki St.	At -12 C° 68 J
JRQ	J3 & J6		1/4		T-L		-15.8	-33.9	0.0	-23.6	15.9	204.5	Ueda et al.	JAERI	
JRQ	SF3	0	diff.	more	LT		-13.0	-22.0	-29.0	-16.0	-2.0	212.0	Wallin et al	VTT	T35=-25 C
JRQ	USSR2	65			T		12.0	4.7	0.0	0.0	0.0	161.0	Kryukov, A.	Kurchatov	
JWN	FRG3	JWN			T-L	no	-44.8	-54.4	0.0	-46.3	-43.6	195.1	Schmitt & al	GKSS	
JWN	J0	1	1/4				-70.0	-77.0	0.0	-60.0	-43.0	0.0		Nippon Steel	NDTT=-40 C°

Table 2. (continued)

MATERIAL	CODE	BLOCK	DEPTH	LAYER	ORIENT	HEATTREATM	T68	T41	T28	T09	FATT	USE ^b	ENGINEER	INSTITUTE	REMARK
JWN	J0	1	2/4				-44.0	-58.0	0.0	-38.0	-38.0	0.0		Nippon Steel	NDTT=-35 C°
JWN HAZ	J0	1	1/4				-78.0	-94.0	0.0	-88.0	-47.0	231.0		Yokohama I.	NDTT=-50 C°
JWN HAZ	J0	1	2/4				-85.0	-96.0	0.0	-94.0	-60.0	235.0		Yokohama I.	NDTT=-60 C°
JWN WELD	J0	1	1/4				-64.0	-73.0	0.0	-68.0	-45.0	202.0		Yokohama I.	NDTT=-65 C°
JWN WELD	J0	1	2/4				-58.0	-68.0	0.0	-63.0	-28.0	198.0		Yokohama I.	NDTT=-70 C°
JWO	FRG3	JWO		T-L	no		-47.4	-63.2	0.0	-50.4	-43.3	196.7	Schmitt & al	GKSS	
JWO WELD	J0		1/4				-68.0	-79.0	0.0	-72.0	-60.0	183.0		Mitsubishi	NDTT=-65 C°
JWP	FRG3	JWP		T-L	no		-44.6	-57.1	0.0	-46.3	-42.4	186.7	Schmitt & al	GKSS	
JWP	USSR2			T			-40.0	-59.0	0.0	0.0	0.0	189.0	Kryukov, A.	Kurchatov	
JWP HAZ	J0		1/4				-80.0	-80.0	0.0	-80.0	-80.0	280.0		Babcock Hit.	NDTT=-65 C° TTKV<-80 C°!
JWP WELD	J0		1/4				-52.0	-65.0	0.0	-62.0	-40.0	215.0		Babcock Hit.	NDTT=-60 C°
JWQ	CS3	JWN	55	T-L	no		-28.0	-50.0	0.0	-35.0	0.0	248.0	M.Brumowsky	UJV Rez	
JWQ	FRG3	JWQ		T-L	no		-28.9	-46.0	0.0	-35.2	-20.6	181.6	Schmitt & al	GKSS	
JWQ	GDR4	0					-34.0	-50.0	-61.0	-40.0	-19.0	193.0	Popp et al.	Rosendorf	weld metal
JWQ	USSR2			T			-22.0	-34.5	0.0	0.0	0.0	174.0	Kryukov, A.	Kurchatov	
JWQ HAZ	J0		1/4				-68.0	-78.0	0.0	0.0	-60.0	207.0		Babcock Hit.	NDTT=-65 C°
JWQ WELD	J0		1/4				-34.0	-50.0	0.0	-24.0	-22.0	207.0		Babcock Hit.	NDTT=-55 C°

^aUnit for transition temperature is °C.^bUnit for USE if joule (J).

Table 3. Irradiated Materials' Transition Temperatures^a in CRP-3

MATERIAL	CODE	BLOCK	DEPTH	ORIENT	FLUENCE MEV	IRRAD TEMP	HEATTREATM	T68	T41	T28	T09	FATT	USE ^b	INSTITUTE	REMARK
FFA	SF11			L-T	1.50.10E19	265.0		-1.0	-17.0	-28.0	-10.0	14.0	200.0	VTT & IVO	
JFL	SF11			L-T	1.56.10E19	265.0		-7.0	-18.0	-25.0	-8.0	4.0	210.0	VTT & IVO	
JFL	CS1	51	55	C-L	2.6	288.0	no	-24.0	-39.0	0.0	-26.0	0.0	198.0	Skoda	Shift:31;32;-;31;-; -24J
JFL	J3 & J6			T-L	1.90	290.0		-37.4	-55.7	0.0	-45.9	-5.5	188.9	JAERI	Shift:35;37;-;35;19 -37J
JPA	FRG3	JPA2		T-L	0.57	290.0	no	52.9	32.9	0.0	52.6	65.0	171.7	GKSS	
JPB	FRG3	JPB3		T-L	0.58	290.0	no	-24.8	-33.7	0.0	-24.9	-10.8	211.2	GKSS	
JPC	FRG3	JPC3		T-L	0.58	290.0	no	-45.4	-58.3	0.0	-47.1	-21.5	214.6	GKSS	
JPD	J3 & J6			T-L	2.33	290.0		-27.6	-45.0	0.0	-33.1	7.6	206.5	JAERI	Shift:51;48;-;48;33 -27J
JPD	FRG3	JPD6		T-L	0.58	290.0	no	-19.0	-27.3	0.0	-19.9	-6.6	218.5	GKSS	
JPDI	Ind3		1/4	LT	1.0	290.0		-33.5	-38.5	0.0	-35.8	0.0	0.0	Bhabha A.R.C	
JPE	FRG3	JPE6		T-L	0.58	290.0	no	-12.9	-23.7	0.0	-16.7	4.6	235.7	GKSS	
JPF	J3 & J6		1/4	T-L	1.77	290.0		-17.3	-47.5	0.0	-13.8	25.1	168.0	JAERI	Shift:64;54;-;73;67 -63J
JPF	FRG3	JPF6		T-L	0.58	290.0	no	-11.5	-26.0	0.0	-11.3	8.3	201.3	GKSS	
JPF	E6				3.00	290.0		59.1	23.9	0.0	41.8	0.0	0.0		
JPF	E6				3.00	290.0	400C/168h	-2.4	-21.8	0.0	-11.6	0.0	0.0		
JPG	FRG3	JPG7		T-L	0.58	290.0	no	-8.9	-21.8	0.0	-10.7	13.1	212.3	GKSS	
JPGI	Ind3		1/4 ?	LT ?	1.0	290.0		-21.2	-40.2	0.0	-27.1	0.0	0.0	Bhabha A.R.C	
JPH	J3 & J6			T-L	2.15	290.0		-21.3	-58.1	0.0	-27.4	31.0	180.4	JAERI	Shift:59;39;-;57;71 68J
JPH	FRG3	JPH3		T-L	0.58	290.0	no	-9.8	-23.7	0.0	-10.2	14.4	215.2	GKSS	
JPI	J3 & J6		1/4	T-L	1.88	290.0		-52.3	-71.3	0.0	-57.5	-23.6	182.0	JAERI	Shift:34;29;-;33;19 -25J
JPJ	J3 & J6		1/4	T-L	2.17	290.0		38.3	22.2	0.0	30.0	49.9	165.2	JAERI	Shift:62;59;-;55;52 -67J
JPJ	E6				3.00	290.0		61.2	41.8	0.0	45.7	0.0	0.0		
JPJ	E6				3.00	290.0	400C/168h	30.4	8.9	0.0	16.2	0.0	0.0		
JRQ	SF11			L-T	1.59.10E19	265.0		115.0	96.0	84.0	122.0	112.0	129.0	VTT & IVO	
JRQ	USSR2	65		T	6.50	270.0		127.0	114.0	0.0	0.0	0.0	86.0	Kurchatov	Shift:115;108;-;-;- -
JRQ	USSR2	65		T	3.15	270.0		79.0	63.0	0.0	0.0	0.0	128.0	Kurchatov	Shift: 67; 58;-;-;- -
JRQ	USSR2	65		T	6.50	270.0	460/72h	37.0	0.0	0.0	0.0	0.0	135.0	Kurchatov	Shift:20;-;-;-;- -
JRQ	USSR2	65		T	3.15	270.0	460/72h	32.0	18.8	0.0	0.0	0.0	190.0	Kurchatov	Shift:20;-;-;-;- -
JRQ	CS3	64	55	T-L	4.2	270.0	no	134.0	110.0	0.0	134.0	0.0	192.0	UJV Rez	
JRQ	CS1	62	35	T-L	2.6	288.0		63.0	44.0	0.0	61.0	0.0	172.0	Skoda	Shift:80;77;-;81;-; -52J
JRQ	USSR2	65		T	4.80	290.0		113.0	98.0	0.0	0.0	0.0	128.0	Kurchatov	Shift:112;114;-;-;- -
JRQ	USSR2	65		T	4.80	290.0	460/72h	25.5	24.0	0.0	0.0	0.0	182.0	Kurchatov	Shift:12;-;-;-;- -
JRQ	CH7	65	55	T-L	0.39	290.0		28.0	10.0	0.0	0.0	0.0	212.0	PSI	Shift:39;33;-;-;- +13J
JRQ	CH7	65	55	T-L	2.23	290.0		63.0	35.0	0.0	0.0	0.0	171.0	PSI	Shift:74;58;-;-;- -28J
JRQ	CH7	65	55	T-L	3.84	290.0		77.0	57.0	0.0	0.0	0.0	165.0	PSI	Shift:88;80;-;-;- -34J
JRQ	CH7	65	55	T-L	1.93+1.93	290.0	460C/18h	74.0	52.0	0.0	0.0	0.0	178.0	PSI	Shift:85;75;-;-;- -21J
JRQ	CH7	65	55	T-L	2.26+2.26	290.0	460C/18h	64.0	41.0	0.0	0.0	0.0	174.0	PSI	Shift:75;64;-;-;- -25J
JRQ	J3 & J6		1/4	T-L	2.32	290.0		79.3	57.0	0.0	67.5	99.0	144.4	JAERI	Shift:95;91;-;91;83 -60J

Table 3. (continued)

MATERIAL	CODE	BLOCK	DEPTH	ORIENT	FLUENCEMEV	IRRAD TEMP	HEATTREATM	T68	T41	T28	T09	FATT	USE	INSTITUTE	REMARK
JRQ	FRG3	JRQ1		T-L	2.24	290.0	no	94.6	73.2	0.0	89.2	99.4	162.0	GKSS	
JRQ	FRG3	JRQ1		T-L	2.45	290.0	no	95.3	76.1	0.0	89.1	101.0	157.6	GKSS	
JRQ	FRG3	JRQ1		T-L	2.02	290.0	no	75.8	56.1	0.0	71.2	83.8	162.3	GKSS	
JRQ	FRG3	JRQ2		T-L	0.58	290.0	no	41.0	26.1	0.0	37.1	53.9	180.5	GKSS	
JRQ	E6				3.00	290.0		111.6	95.8	0.0	87.0	0.0	0.0		
JRQ	E6				3.00	290.0	400C/168h	35.3	19.3	0.0	27.7	0.0	0.0		
JRQ	E6				0.36	290.0		0.0	39.7	0.0	37.8	0.0	0.0		
JRQ	E6				1.00	290.0		0.0	80.5	0.0	60.8	0.0	0.0		
JRQ	E6				0.36	290.0	450C/168h	0.0	-14.0	0.0	3.4	0.0	0.0		
JRQ	E6				1.00	290.0	450C/168h	0.0	11.2	0.0	23.6	0.0	0.0		
JRQ	E6				3.00	290.0	450C/168h	0.0	13.8	0.0	28.1	0.0	0.0		
JRQ	E6				1.00	290.0	400C/168h	0.0	11.5	0.0	15.3	0.0	0.0		
JRQ	CH8				5.00	290.0		92.0	70.0	0.0	0.0	0.0	145.0	PSI	calculated values
JWN	FRG3	JWN		T-L	2.00	290.0	no	-28.3	-37.8	0.0	-29.3	-31.3	211.8	GKSS	
JWO	FRG3	JWO		T-L	1.97	290.0	no	-40.7	-52.1	0.0	-41.5	-36.2	216.4	GKSS	
JWP	USSR2			T	6.70	270.0		14.0	6.7	0.0	0.0	0.0	134.0	Kurchatov	Shift:54;66;-;-;-
JWP	USSR2			T	4.35	270.0		-5.0	-16.0	0.0	0.0	0.0	169.0	Kurchatov	Shift:35;44;-;-;-
JWP	USSR2			T	6.70	270.0	460/72h	-26.5	-36.0	0.0	0.0	0.0	180.0	Kurchatov	Shift: 0; -;-;-;-
JWP	USSR2			T	3.35	290.0		-23.0	-38.0	0.0	0.0	0.0	164.0	Kurchatov	Shift:17;22;-;-;-
JWP	FRG3	JWP		T-L	1.95	290.0	no	-24.8	-39.4	0.0	-26.0	-25.3	205.5	GKSS	
JWQ	USSR2			T	6.25	270.0		209.0	165.0	0.0	0.0	0.0	104.0	Kurchatov	Shift:231;199;-;-;-
JWQ	CS3	JWN	55	T-L	4.2	270.0	no	188.0	155.0	0.0	188.0	0.0	197.0	UJV Rez	
JWQ	USSR2			T	4.50	290.0		113.0	94.0	0.0	0.0	0.0	107.0	Kurchatov	Shift:135;130;-;-;-
JWQ	USSR2			T	4.50	290.0	460/72h	8.0	-10.0	0.0	0.0	0.0	188.0	Kurchatov	Shift:30; -;-;-;-
JWQ	FRG3	JWQ		T-L	1.93	290.0	no	123.6	92.5	0.0	132.4	110.0	154.8	GKSS	

^aUnit for transition temperature is °C.^bUnit for USE is joule (J).

Fig. 1. Structures of IAEA IDRPVM Database

Fig. 2. Architecture of Embrittlement Data Base (EDB).

Table 4. Fit of the EDB in the Structure of the IDRPM

GROUP DATA	SUBGROUP DATA	USNRC/ORNL EDB	IAEA IDRPM
Material Identification	<ul style="list-style-type: none"> • Material Chemistry • Material Supplier • Utility Supplying Data • Base Material Technology • Weld Material Technology • HAZ Material Technology 	CHEM HEAT_LST REAC_LST HEAT WELD HAZ	RPV_MAT RPV_GEN RPV_UTIL RPV_TEC RPV_WEL
Aging History	<ul style="list-style-type: none"> • Irradiation Environment • Thermal Aging Environment 	REAC REAC	RPV_IRR RPV_THR
Mechanical Testing	<ul style="list-style-type: none"> • Tensile Testing Results • Charpy-V Impact Testing • Static Fracture Testing • Dynamic Fracture Testing • Hardness Testing • Transition Temperature & Hyperbolic Tangent Coefficients • Parameters of Exponential Fit for Fracture Toughness Data 	TENSILE CHARPY KIC, KJC KID, KJD HARDNESS SHFT_CV & RAW_C_RS	RPV_TEN RPV_CV RPV_SFR RPV_DFR RPV_HRD RPV_TT RPV_EXP
References	List of References List of Related References	REF_LST REF_TITL	RPV_REF RPV_REL
Nondestructive Testing	Metallography Pictures Other Nondestructive Test Procedures		RPV_MET RPV_NDT
Collected Curves	ASCII Diagrams of Data Digitalized Pictures of Data	(Instrumented Charpy data only)	RPV_DIA RPV_PIC

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