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INTERIM REPORT

LWR PRESSURE VESSEL IRRADIATION SURVEILLANCE

DOSIMETRY PROGRAM BI-MONTHLY STATUS LETTER

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April 7, 1980

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FEBRUARY-MARCH BI-MONTHLY STATUS LETTER: LWR PRESSURE VESSEL IRRADIATION SURVEILLANCE DOSIMETRY PROGRAM

The objective of this program is to make measurements in neutron fields ["Benchmark" and reactor "Test and Surveillance Regions"] for the subsequent validation/calibration of available state-of-the-art data and dosimetry, damage correlation, and the associated reactor analysis procedures used for predicting the integrated effect of neutron exposure for light-water reactor [LWR] pressure vessel [PV] steel test irradiation and surveillance programs. The task includes selection of the neutron fields, the validation/calibration of dosimetry and damage exposure and correlation procedures in these fields, and the establishment of a set of seventeen ASTM recommended standard practices, guides, and methods.

PROGRAM REVIEW AND DEFINITION

Revised FY 1980 work statements for Task A, B, and C were prepared and submitted to NRC for the March 10, 1980 NRC Buff Book. Figures 1 and 2 show an updated set of seventeen ASTM Standards and the preparation, validation, calibration, and acceptance schedule for their development.

TASK A - NEUTRON FIELDS

ORNL-PSF Dosimetry PV Mockup Validation/Calibration Studies

The ORR-PSF nine day LWR Power Reactor perturbation test irradiation of the mockup surveillance capsules was completed February 9, 1980. Three detector

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AUTHOR(S): CC Preston, HEDL C/39, 2-[illegible]; WH McElroy, HEDL, 2-3701

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BC-7600-062 (5-76)

set shipments were made to HEDL, the last sets being received March 6, 1980. Relative and correlative absolute counting of the 168 interlaboratory comparison samples was completed and replicate sample sets were shipped to the six utility/vendor/service laboratories March 19, 1980. Preliminary data indicates relative precision of the majority of the replicate foils was excellent, being $\leq \pm 2\%$ (with no correction for possible axial gradient effects). The remainder of the foils, with the exception of Co, indicate relative precisions better than ±3.2%. The $^{59}Co(n,\gamma)$ data had apparent group relative precision values of ±3% to ±5%; which are greater than anticipated and the reason for this is being investigated. This increased data scatter of the Co data can, possibly, be explained by self-shielding, gradient, or configuration effects. Counting of the remainder of the HEDL dosimeter foils is about two thirds complete.

Radiochemical analysis of the PSF startup foils is also about two thirds complete. Preliminary data analysis on both PSF tests is expected to be completed and available for discussion at the May program review meeting.

ORNL-PCA Dosimetry PV Mockup Validation/Calibration Studies

SSTR results have been obtained for the $^{238}U(n,f)$ fission rate measurements at the T/4, T/2, and 3/4T positions in the pressure vessel simulator for the PCA 8/7 configuration. Preliminary comparisons with the NBS-MOL results indicate good agreement for the shape of the axial distribution of the fission rates. These data will be submitted for use in the PCA "Blind Test."

Other Neutron Fields

Final counts are being made on the fission foil dosimeters from the fourth irradiation in the Arkansas Number One cavity. Radiochemical results are expected to be completed by the end of April.

TASK B - RECOMMENDED ASTM STANDARDS

With reference to Figures 1 and 2, a revised version of the Master Matrix Guide (0) is being prepared for joint ASTM E10.05 and E10.02 ballot. The Master Matrix Guide is now shown as one of a set of seventeen standards. In previous reports, fifteen standards were identified. Partially completed copies of the revised Guide were distributed to a number of participants for comments in early March. A new standard, "Correlation of ΔNDTT With Fluence," (II-F), is shown in Figures 1 and 2. ASTM Subcommittee E10.02 will have the lead responsibility for its preparation, but the E10.05.06 Task Group on "Exposure Units" will assist E10.02 in its preparation.

TASK C - DAMAGE AND CORRELATION PROCEDURES

MPC Data Base Re-evaluation Studies

Least squares fitting results have been obtained for the equation

$$\Delta NDTT_{CV\text{-}30} = (A + B \cdot \ Cu(Wt\ \%)) \times \left(\frac{\phi t}{10^{19}}\right)^{N}$$

using two different very large data sets. The data sets are for 144 data points from surveillance irradiations and 101 data points from test reactor irradiations. The results show a lower value for N, the fluence exponent, for the surveillance data,

than for the test reactor data. This suggests the presence of a saturation effect. This work was done at the request of N. Randall of NRC in anticipation of different values of N for the two sets of data.

As previously reported, a request was made in December to Stan Anderson of Westinghouse for some detailed information regarding the neutron spectrum, power time history, and local flux perturbations in Westinghouse PWR's. This information was needed for the re-examination of MPC data base surveillance results from Westinghouse PWR's. The available information has now been received, and the study is continuing.

EPRI contractors cooperating with HEDL in data base (mechanical properties vs. irradiation parameters) re-examination have indicated that they will provide HEDL with a computer tape version of all mechanical property information assimilated to date on the EPRI data base. HEDL is now sending a blank tape to EPRI contractors in Santa Barbara where the tape will be written.

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Irradiation Environment

CONCURRENCE:

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Irradiation Environment

gd

Enclosures

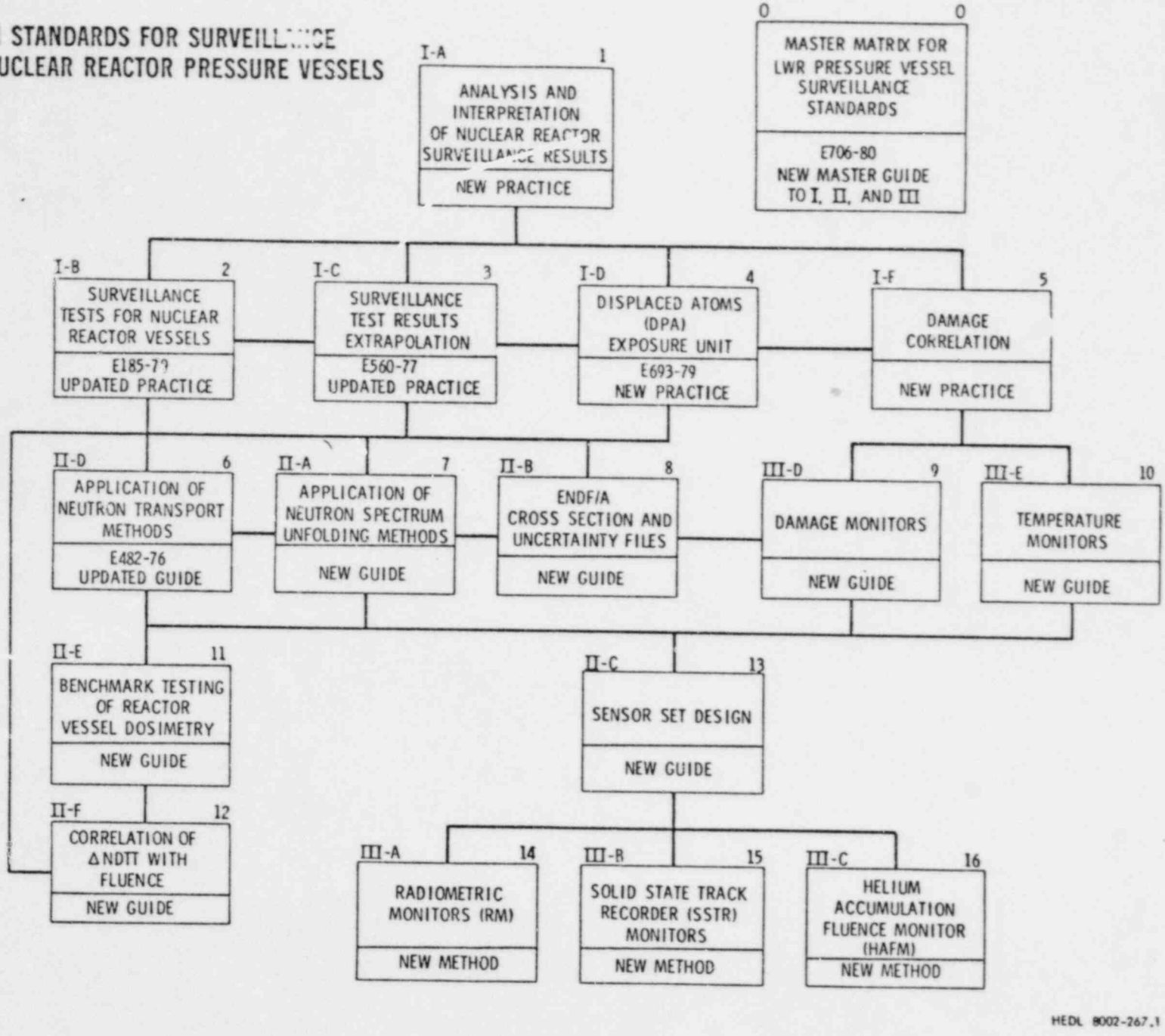

ASTM STANDARDS FOR SURVEILLANCE OF NUCLEAR REACTOR PRESSURE VESSELS
0
0
MASTER MATRIX FOR LWR PRESSURE VESSEL SURVEILLANCE STANDARDS
E706-80
NEW MASTER GUIDE TO I, II, AND III
I-A
1
ANALYSIS AND INTERPRETATION OF NUCLEAR REACTOR SURVEILLANCE RESULTS
NEW PRACTICE
I-B
2
SURVEILLANCE TESTS FOR NUCLEAR REACTOR VESSELS
E185-79
UPDATED PRACTICE
I-C
3
SURVEILLANCE TEST RESULTS EXTRAPOLATION
E560-77
UPDATED PRACTICE
I-D
4
DISPLACED ATOMS (DPA) EXPOSURE UNIT
E693-79
NEW PRACTICE
I-F
5
DAMAGE CORRELATION
NEW PRACTICE
II-D
6
APPLICATION OF NEUTRON TRANSPORT METHODS
E482-76
UPDATED GUIDE
II-A
7
APPLICATION OF NEUTRON SPECTRUM UNFOLDING METHODS
NEW GUIDE
II-B
8
ENDF/A CROSS SECTION AND UNCERTAINTY FILES
NEW GUIDE
III-D
9
DAMAGE MONITORS
NEW GUIDE
III-E
10
TEMPERATURE MONITORS
NEW GUIDE
II-E
11
BENCHMARK TESTING OF REACTOR VESSEL DOSIMETRY
NEW GUIDE
II-C
13
SENSOR SET DESIGN
NEW GUIDE
II-F
12
CORRELATION OF ΔNDTT WITH FLUENCE
NEW GUIDE
III-A
14
RADIOMETRIC MONITORS (RM)
NEW METHOD
III-B
15
SOLID STATE TRACK RECORDER (SSTR) MONITORS
NEW METHOD
III-C
16
HELIUM ACCUMULATION FLUENCE MONITOR (HAFM)
NEW METHOD
HEDL 8002-267.1

FIGURE 1

RECOMMENDED E10 ASTM STANDARDS

0. MASTER MATRIX GUIDE TO I, II, III

I. METHODS OF SURVEILLANCE AND CORRELATION PRACTICES

A. ANALYSIS AND INTERPRETATION OF NUCLEAR REACTOR SURVEILLANCE RESULTS
B. SURVEILLANCE TESTS FOR NUCLEAR REACTOR VESSELS (*)
C. EXTRAPOLATING REACTOR VESSEL SURVEILLANCE RESULTS
D. CHARACTERIZING NEUTRON EXPOSURES IN FERRITIC STEELS IN TERMS OF DISPLACEMENTS PER ATOM, INCLUDING ASTM ENDF/A DPA FILE
E. DAMAGE CORRELATION FOR REACTOR VESSEL SURVEILLANCE

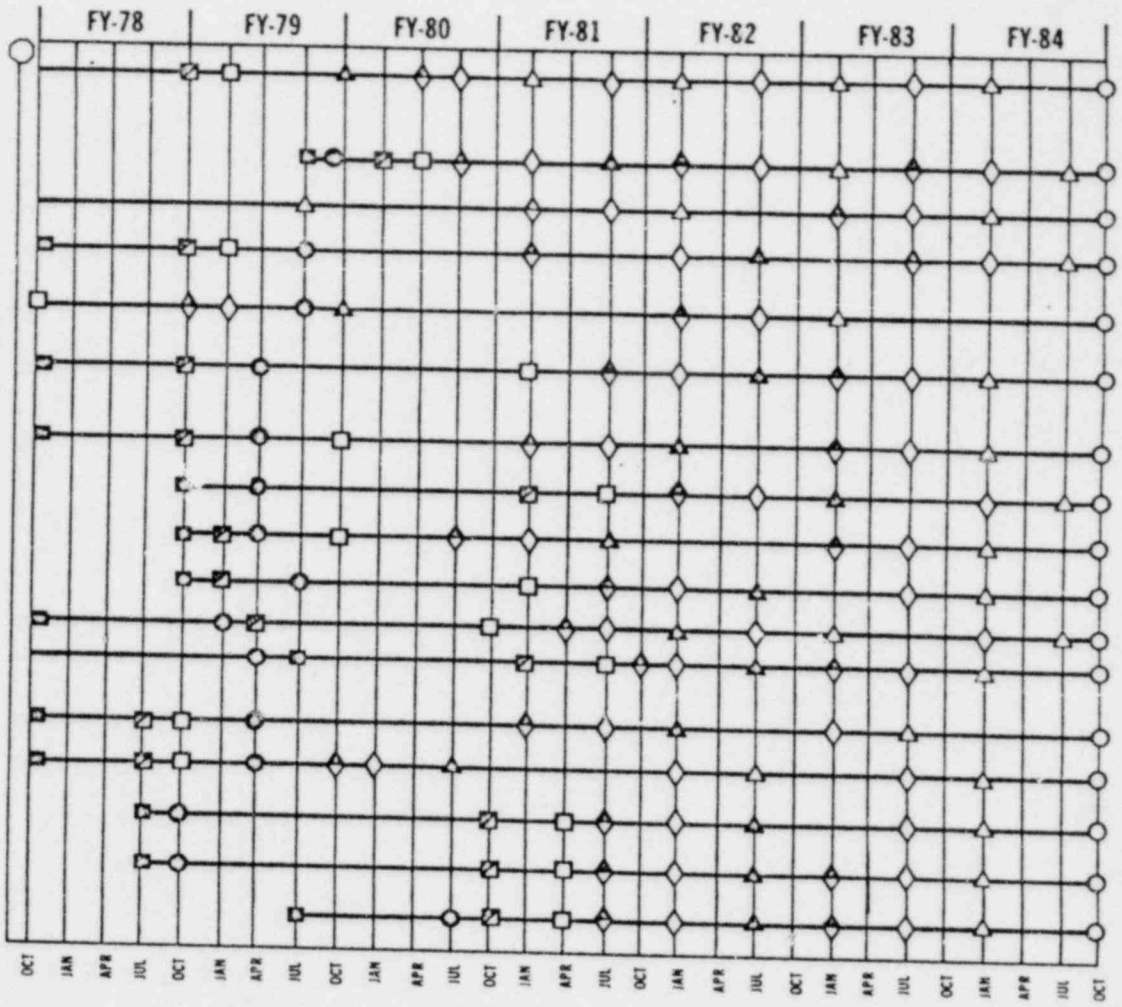
II. SUPPORTING METHODOLOGY GUIDES

A. APPLICATION OF MULTIPLE SENSOR FLUX FLUENCE SPECTRAL DETERMINATION CODES
B. APPLICATION OF ASTM/ENDF/A CROSS SECTION AND ERROR FILE
C. SENSOR SET DESIGN AND IRRADIATION FOR REACTOR VESSEL SURVEILLANCE
D. APPLICATION OF NEUTRON TRANSPORT METHODS FOR REACTOR VESSEL SURVEILLANCE
E. BENCHMARK TESTING OF REACTOR NEUTRON DOSIMETRY
F. CORRELATION OF ΔNDTT WITH FLUENCE (*)

III. SENSOR MEASUREMENTS METHODS

A. ANALYSIS OF RADIOMETRIC MONITORS FOR REACTOR VESSEL SURVEILLANCE
B. ANALYSIS OF SOLID STATE TRACK RECORDER (SSTR) MONITORS FOR REACTOR VESSEL SURVEILLANCE
C. ANALYSIS OF HELIUM ACCUMULATION FLUX/FLUENCE (HAFM) MONITORS FOR REACTOR VESSEL SURVEILLANCE
D. ANALYSIS OF DAMAGE MONITORS FOR REACTOR VESSEL SURVEILLANCE
E. ANALYSIS OF TEMPERATURE MONITORS FOR REACTOR VESSEL SURVEILLANCE

* AN ASTERISK INDICATES THAT THE LEAD RESPONSIBILITY IS WITH SUBCOMMITTEE E10.02 INSTEAD OF WITH SUBCOMMITTEE E10.05.



DRAFT OUTLINE DUE TO ASTM E10 SUBCOMMITTEE TASK GROUPS

INITIAL DRAFT DUE TO ASTM E10 SUBCOMMITTEE TASK GROUPS

1ST DRAFT TO APPROPRIATE ASTM E10 SUBCOMMITTEES

REVISED DRAFT TO APPROPRIATE E10 SUBCOMMITTEES - INCLUDING REQUIRED SUBCOMMITTEE BALLOTING

REVISED DRAFT FOR E10 COMMITTEE AND/OR SOCIETY BALLOTING

PRIMARY TIME INTERVAL FOR ROUND ROBIN VALIDATION AND CALIBRATION TESTS

ACCEPTANCE AS STANDARD

REVISION AND ACCEPTANCE AS STANDARD

HEDL 8002-267.2

FIGURE 2