6/28/88

MT/SC DHEC TRIP REPORT

MEMORANDUM FOR: John J. Surmeier, Chief
Technical Branch
Division of Low-Level Waste Management
and Decommissioning

FROM: Michael Tokar, Section Leader
Technical Branch
Division of Low-Level Waste Management
and Decommissioning

SUBJECT: SC DHEC TRIP REPORT

On June 20, 1988, John Greeves, Kathleen Schneider and I from headquarters and Robert Trojanowski from Region II, visited Virgil Autry, Heyward Shealy and members of their staff at the offices of the South Carolina Department of Health and Environmental Control (DHEC) in Columbia, South Carolina. The purpose of the visit was to discuss Professor Stewart Silling's report on high-density polyethylene (HDPE), high integrity containers (HIC's). The meeting agenda list of attendees are attached.

As indicated by the agenda, we held a technical discussion concerning Silling's major findings and conclusions. We also requested that SC provide any comments they may have on the report for our consideration and discussed the status and future plans for the NRC review of HDPE HIC topical reports. We advised DHEC that we expect to make a decision on these topical reports late this summer. We also advised DHEC of the Advisory Committee on Nuclear Waste Meeting on June 27-28, and suggested that they attend. Also discussed were some of DHEC's concerns regarding the HDPE HIC's already buried at Barnwell and potential future actions concerning further receipt of HDPE HIC's at the Barnwell disposal site.

DHEC expressed appreciation for the meeting and seemed satisfied with the information that was conveyed.

/s/

Michael Tokar, Section Leader
Technical Branch
Division of Low-Level Waste Management
and Decommissioning

8807070038 (3pp)
XA

8/23

MEETING ATTENDEES

6/20/88

John T. Gree	NRC/LLWM	301-492-3344
Michael Tokar	NRC/LLTB	301-492-0590
Kathleen Schneider	NRC/SLITP	301-492-0320
Bob Trojanowski	NRC/RII	404-331-5597
Heyeard A. Shealy	SC/DHEC	803-734-4634
Virgil R. Autry	SC/DHEC	803-734-4633
Pearce O'Kelley	SC/DHEC	803-734-4700
Tracy Price	SC/DHEC	803-734-4700

Mail telephone #'s
CF only

EFFECTS OF CHEMICAL AND GAMMA IRRADIATION ENVIRONMENTS ON THE MECHANICAL PROPERTIES OF HIGH-DENSITY POLYETHYLENE (HDPE)

FIN No.
3291

P. SOO
J. CLINTON

PROGRAM REVIEW AT NRC
JUNE 23, 1988

• Conference discussion between Soo, Silberg, & NRC before the ACNW mtg.

NUCLEAR WASTE AND MATERIALS TECHNOLOGY DIVISION
BROOKHAVEN NATIONAL LABORATORY
DEPARTMENT OF NUCLEAR ENERGY
UPTON, NEW YORK 11973

B/21

SCOPE OF RESEARCH

TO IDENTIFY DEGRADATION MODES FOR VARIOUS CHEMICAL AND IRRADIATION ENVIRONMENTS

THESE INCLUDE:

- AIR, DIW

DIW - De-ionized Water

- IGEPAL CO - 630
  (ASTM TEST SURFACTANT)
- TURBINE OIL
  (POSS. LLW CONTAMINANT)
- SCINTILLATION FLUID
  (POSS. LLW CONTAMINANT)
- GAMMA RADIATION

HDPE ←
0.9 gm/cc = density

cross linked variety
improvement in the "state of the art"

TYPES OF MECHANICAL TESTS ON HDPE

1. STATIC U-BEND

   - SIMPLE, INEXPENSIVE, VERSATILE SCOPING TEST

2. DYNAMIC CREEP-RUPTURE

   - QUANTITATIVELY COMPARES CREEP RATES, FAILURE TIMES, DUCTILITIES FOR DIFFERENT ENVIRONMENTS

SCHEMATIC OF HDPE U-BEND

U-BEND TESTS ON HDPE

CHECKS CRACK INITIATION AND PROPAGATION MECHANISMS IN STRESSED HDPE

TEST ENVIRONMENTS INCLUDE:

- GAMMA IRRADIATION
- AIR, DIW ← Oxygen available
- VACUUM
- N_2

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bnl

TYPES OF U-BEND SPECIMEN

U-BENDS PREPARED WITH OUTER SURFACES OF BENDS IN FOLLOWING CONDITIONS:

TYPE I - THE AS-RECEIVED OXIDIZED CONDITION, WHICH WILL HAVE "NATURAL" CRACKS PRESENT, AS A RESULT OF BENDING,

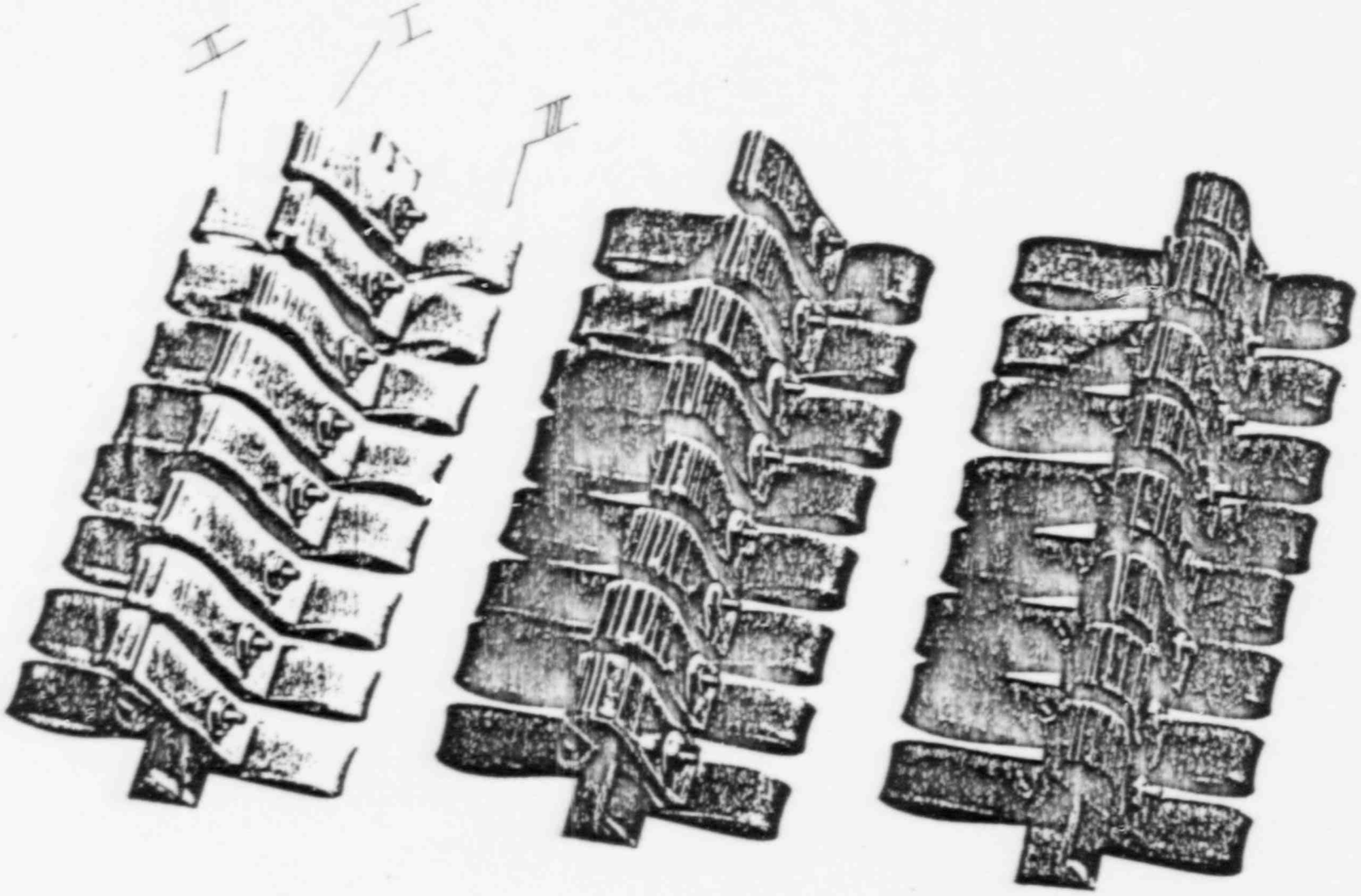
TYPE II - AS ABOVE, BUT WITH 10 MILS OF THE OXIDIZED SURFACE REMOVED WITH SANDPAPER PRIOR TO BENDING, AND

TYPE III - THE AS-RECEIVED "NON-OXIDIZED" SURFACE WHICH DOES NOT CRACK DURING THE BENDING PROCESS.

bend it other way - ID is the non-oxidized surface

Bending Type II there will not be any cracks

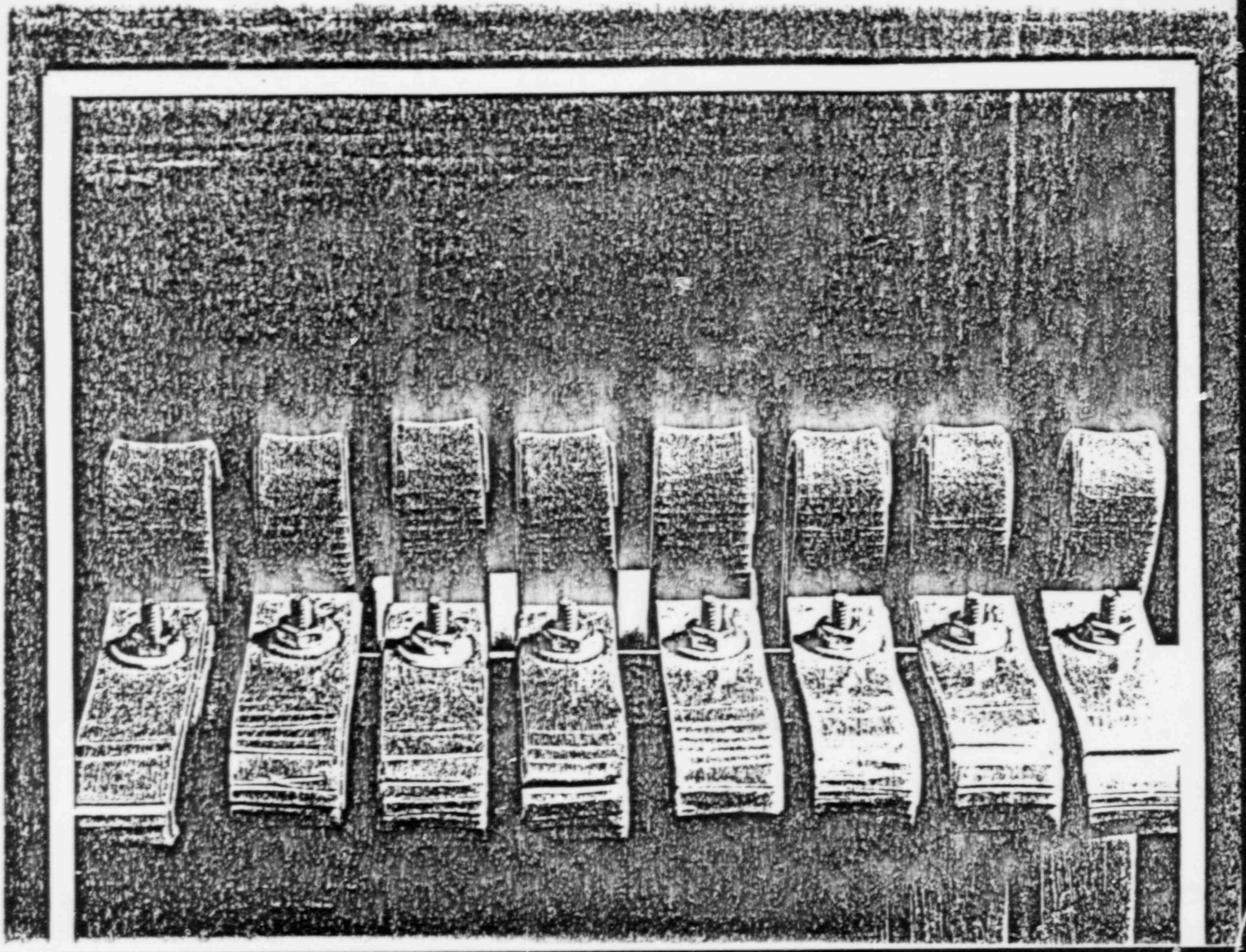
differences



1.4×10^{3} rad/h

8.4×10^{3} rad/h

4.5×10^{5} rad/h



8 samples of each Type

CRACKING IN TYPE I HDPE U-BEND SPECIMENS
EXPOSED TO GAMMA IRRADIATION IN AIR AT 10°C

IRRAD. DOSE (RAD)	NO. OF LARGE CRACKS	NO. OF SMALL CRACKS	NO. OF FULL PENETRATION CRACKS	ADDITIONAL CRACKS CLOSE TO FULL PENET.
0	90	13	0	0
7.5×10^6 (AT 1.4×10^3 R/H)	97	3	2	1
6.0×10^7 (AT 8.4×10^3 R/H)	95	4	2	4
1.3×10^9 (AT 4.4×10^5 R/H)	82	4	0	1

CRACK LOCATION AND DEPTH FOR TYPE I SPECIMENS

- SMALL CRACK MORE EASILY INITIATED IN UNIRRADIATED SPECIMENS
- CRACKS PROPAGATE MOST EASILY AT INTERMEDIATE GAMMA IRRADIATION RATES
- CRACKS PROPAGATE MOST EASILY AT INTERMEDIATE STRESS LEVELS

CRACK LOCATION AND DEPTH FOR TYPE II AND TYPE III SPECIMENS

- CRACK INITIATION FOUND RECENTLY IN TYPE II AND III U-BENDS (DOSE 6.0×10^7 RADS)

- CRACKING LESS PRONOUNCED IN TYPE II SPECIMENS

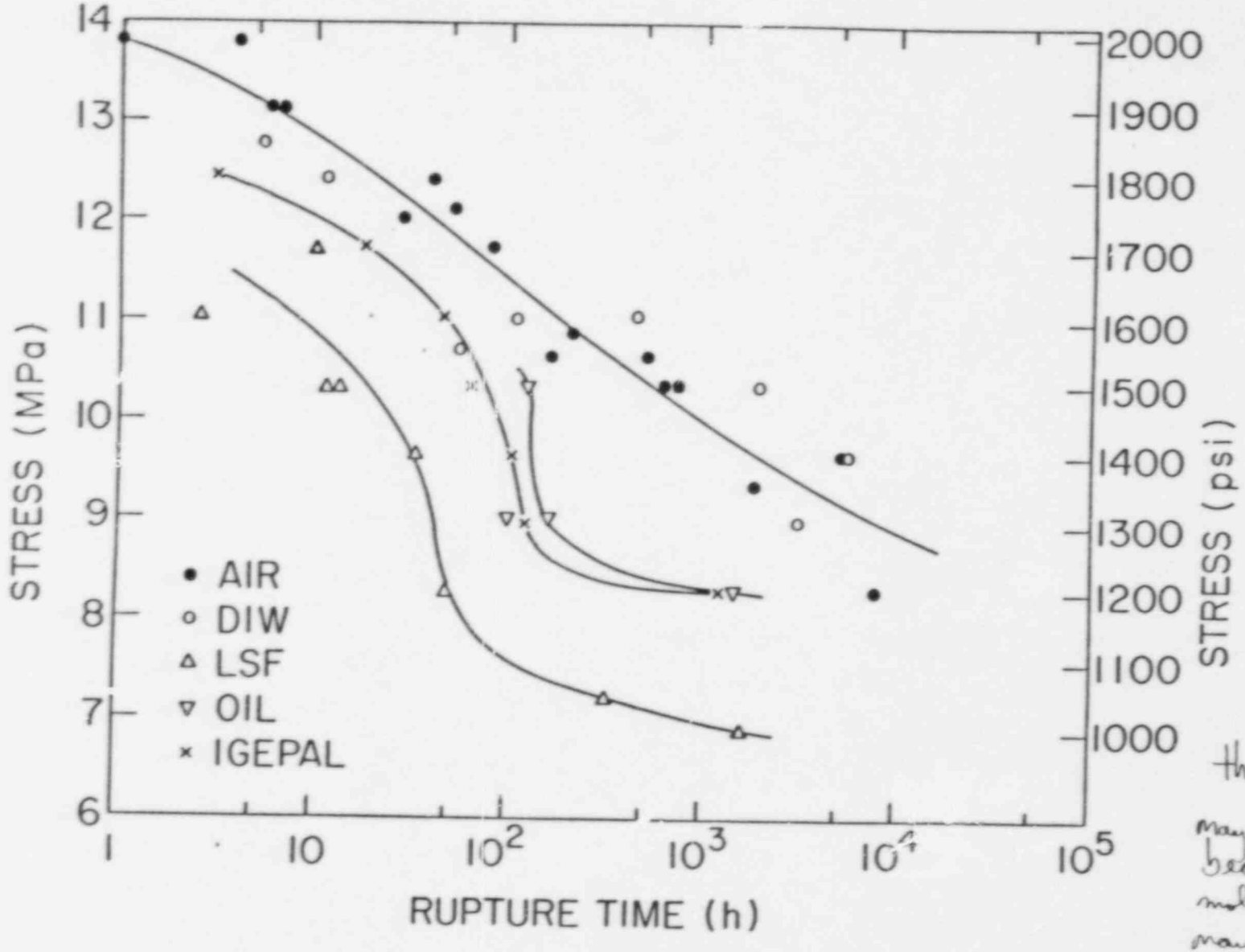
CREEP-RUPTURE TESTS ON HDPE

BASIC DATA NEEDS FOR ANALYZING CREEP DEFORMATION IN HIC'S INCLUDE:

- CREEP STRAIN (ELONGATION) WITH TIME
- CREEP FAILURE TIME

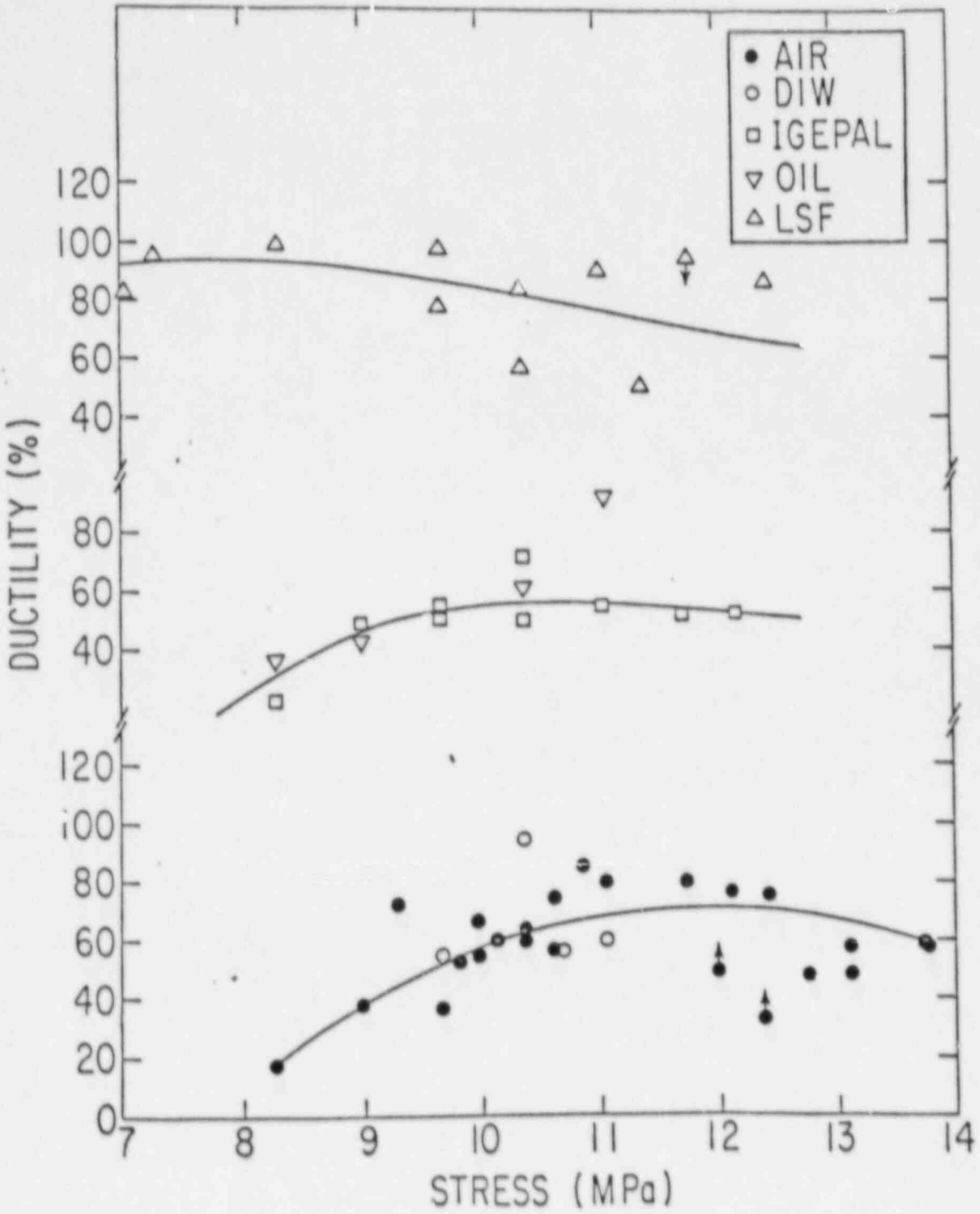
TEST VARIABLES INCLUDE:

- SPECIMEN SURFACE PREPARATION
- APPLIED STRESS
- TEST ENVIRONMENT

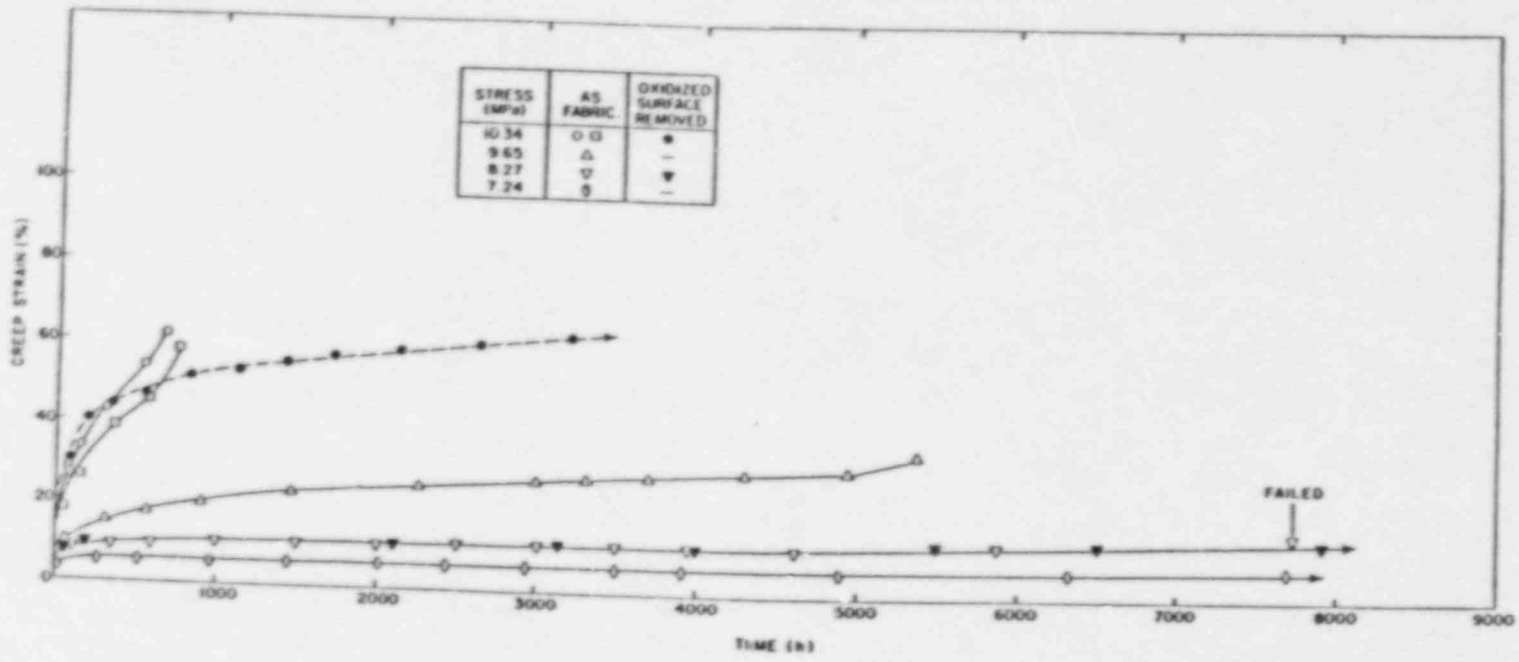


threshold level

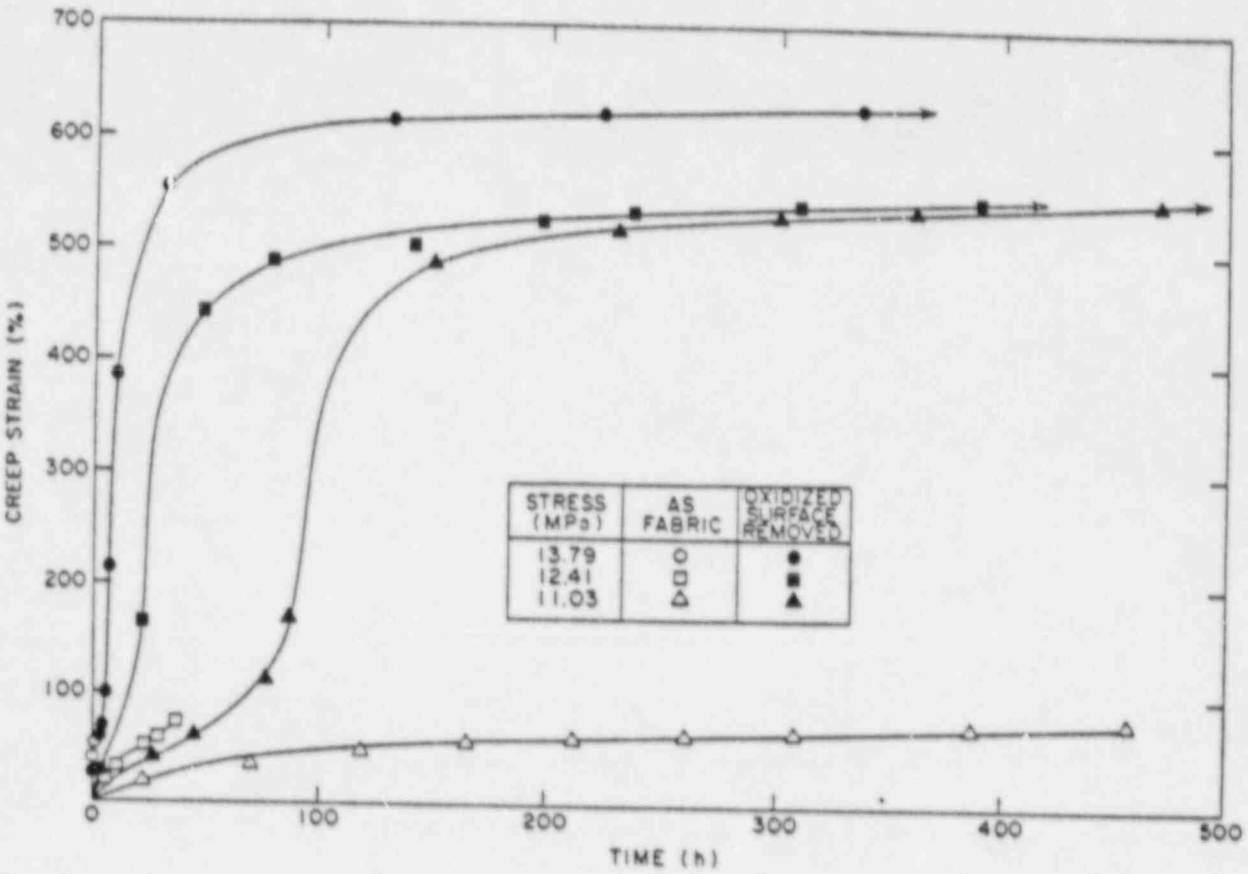
may be present because the molecular bonds may not transition to brittle.



Elongations at failure for Marlex CL-100 HDPE tested at 20°C in various environments.



Effect of surface oxidation on the creep of Marlex CL-100 HDPE in air at stresses between 7.24 and 10.34 MPa (1050 and 1500 psi), inclusive.



Effect of surface oxidation on the creep of Marlex CL-100 HDPE in air at stresses between 11.03 and 13.79 MPa (1100 and 2000 psi), inclusive.

OBSERVATIONS ON CREEP IN HDPE

- CRACKS FORM EARLY IN OXIDIZED LAYER GIVING CONCENTRATED DEFORMATION.
- REMOVAL OF OXIDIZED MATERIAL PREVENTS EARLY CRACKING AND CAUSES MAJOR INCREASES IN DUCTILITY AND CREEP LIFE.
- AT THE HIGHEST STRESSES, DUCTILITIES ARE ESSENTIALLY INDEPENDENT OF ENVIRONMENT.
- TURBINE OIL AND IGEPAL CAUSE ENVIRONMENTAL STRESS CRACKING AT LOW AND INTERMEDIATE STRESSES.
- SCINTILLATION FLUID CAUSES HIGH DUCTILITY AT INTERMEDIATE STRESSES. MORE BRITTLE BEHAVIOR AT LOWER STRESSES.

CONCLUSIONS

1. TENSILE STRESSES, OXYGEN AND GAMMA-IRRADIATION ENCOURAGE CRACK INITIATION AND PROPAGATION IN HDPE.

   INTERMEDIATE STRESSES AND DOSE RATES ARE MOST DETRIMENTAL.

2. SCINTILLATION FLUIDS INCREASE CREEP RATE AND CAUSE VERY EARLY FAILURE BECAUSE OF "SURFACE SOFTENING" EFFECTS.

3. OIL AND SURFACTANTS CAUSE EARLY FAILURE DUE TO ENVIRONMENTAL STRESS CRACKING.

4. REMOVAL OF OXIDIZED SURFACE MATERIAL CAN GREATLY INCREASE FAILURE TIME BY AVOIDING CONCENTRATED DEFORMATION AT CRACKED REGIONS.

5. GAMMA IRRADIATION WILL ENCOURAGE CRACK INITIATION/ PROPAGATION. HOWEVER, AT HIGH DOSE RATES, STRESS RELAXATION AND CHEMICAL CHANGES REDUCE THE EFFECT.

IRRADIATION - CREEP IN HDPE

- RESEARCH INITIATED TO CHECK ON APPARANT INCONSISTENCIES IN TWO PRIOR PROGRAMS.

- ONE SHOWED THAT IN-TEST IRRADIATION INCREASED CREEP RATE COMPARED TO UNIRRADIATED HDPE. THE OTHER SHOWED IT RETARDED CREEP.

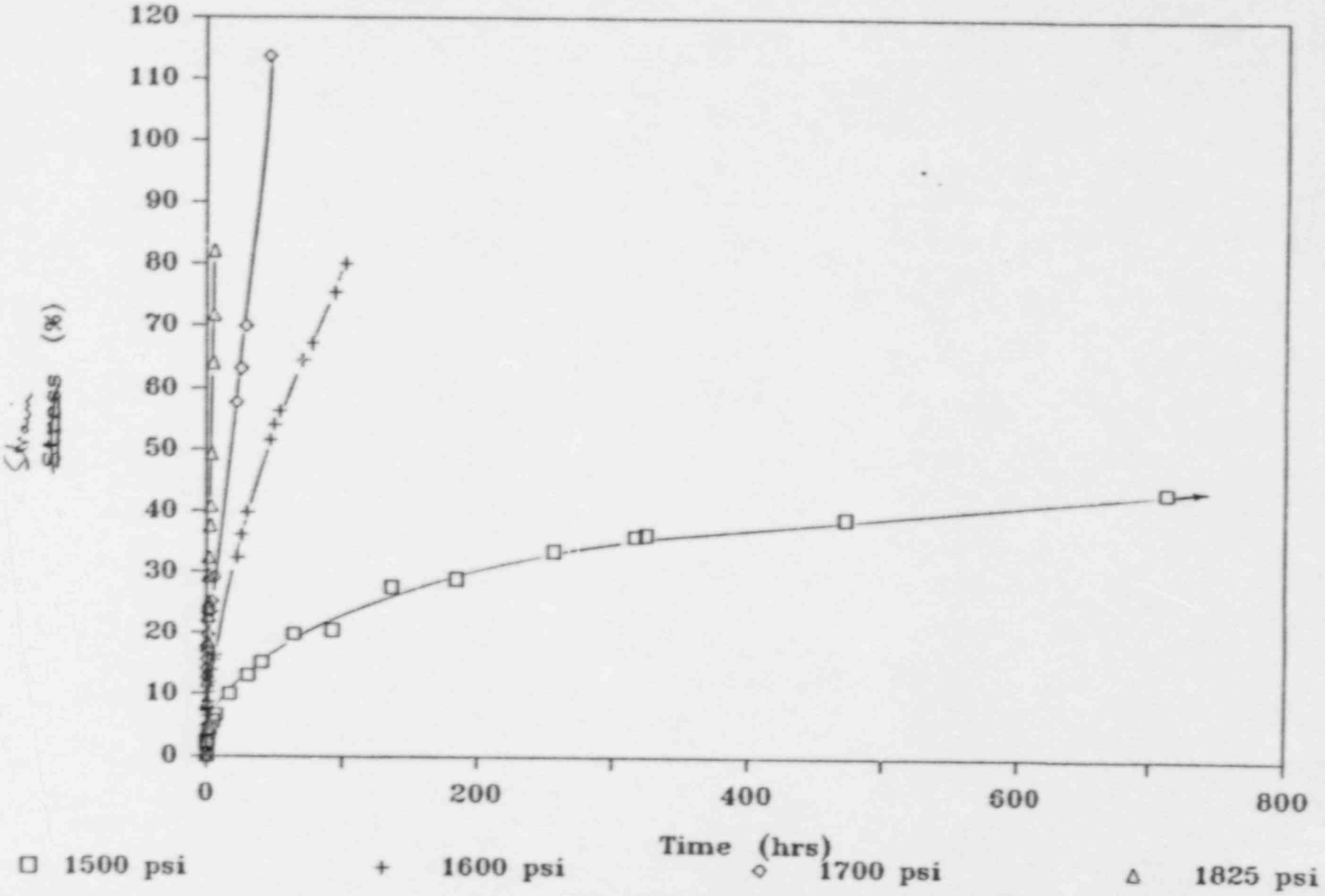
- IT WAS HYPOTHESIZED THAT THE TWO FINDINGS COULD BE RATIONALIZED IF:

  A) HIGHER STRESS AND LOWER DOSE RATES INCREASED CREEP RATE; AND

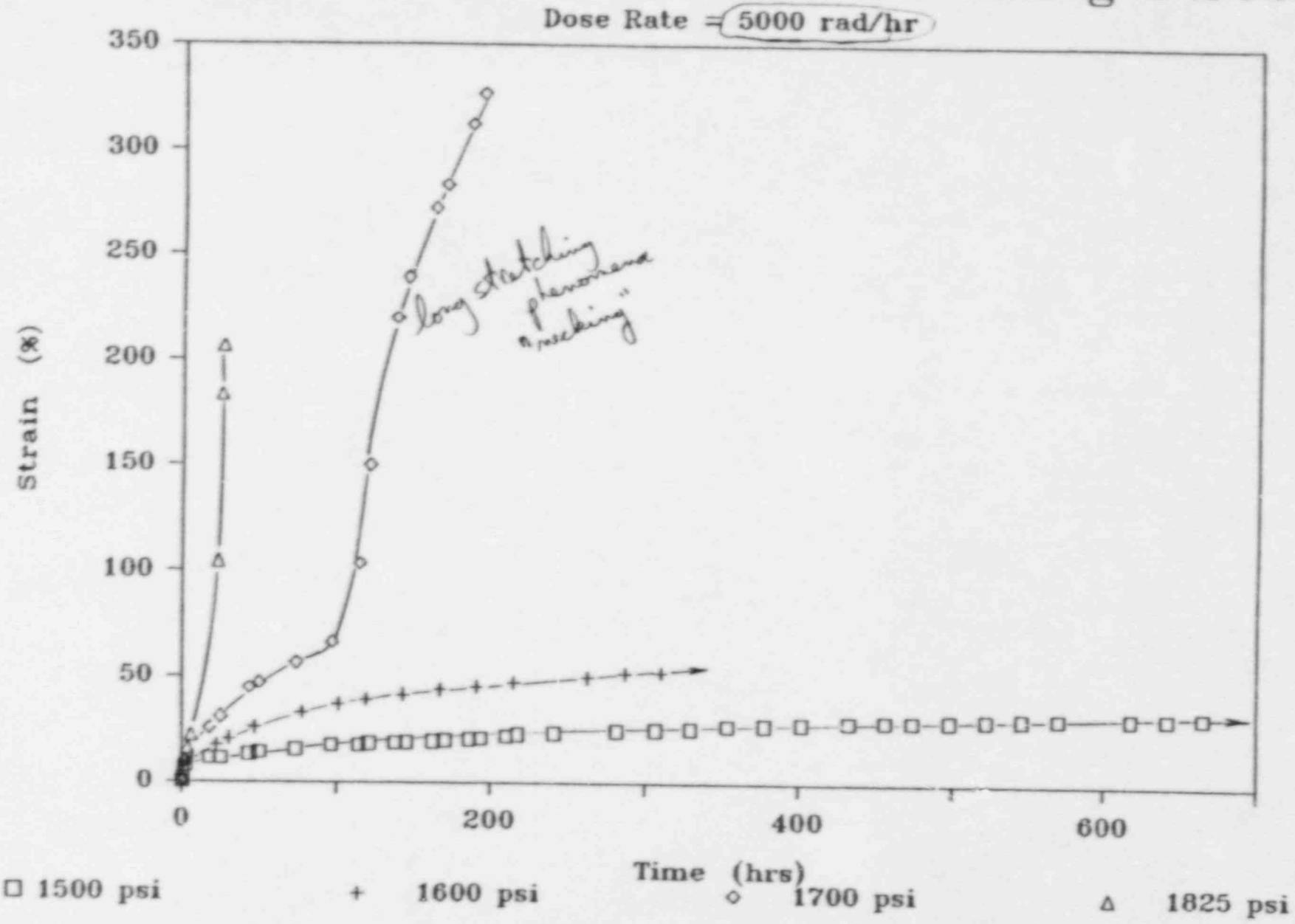
  B) LOWER STRESS AND HIGHER DOSE RATES RETARDED CREEP.

- NEW TESTS ENCOMPASS THE COMPLETE RANGES OF STRESS AND DOSE RATES OF THE TWO PRIOR PROGRAMS.

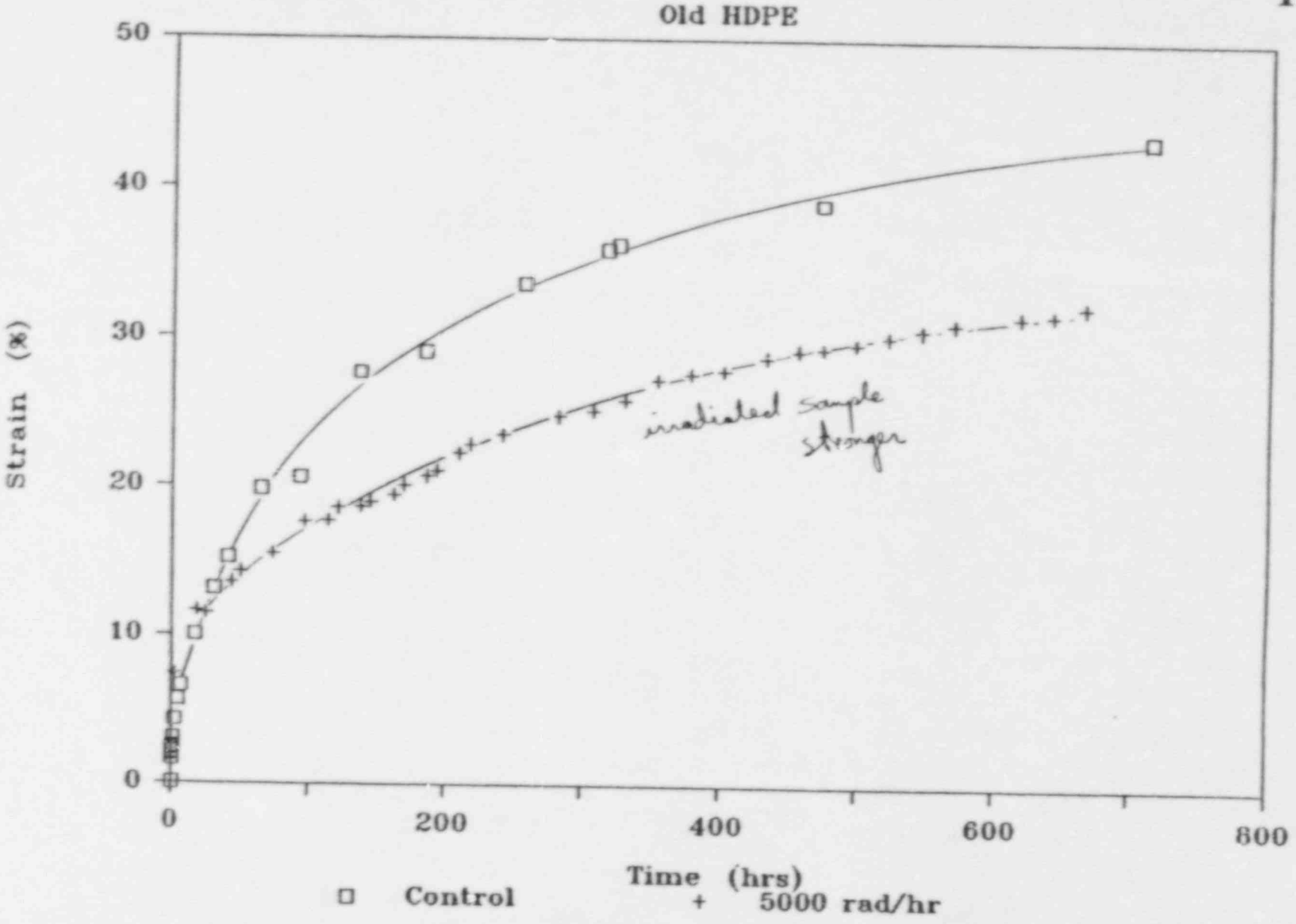
Control Specimens for HDPE Irradiations



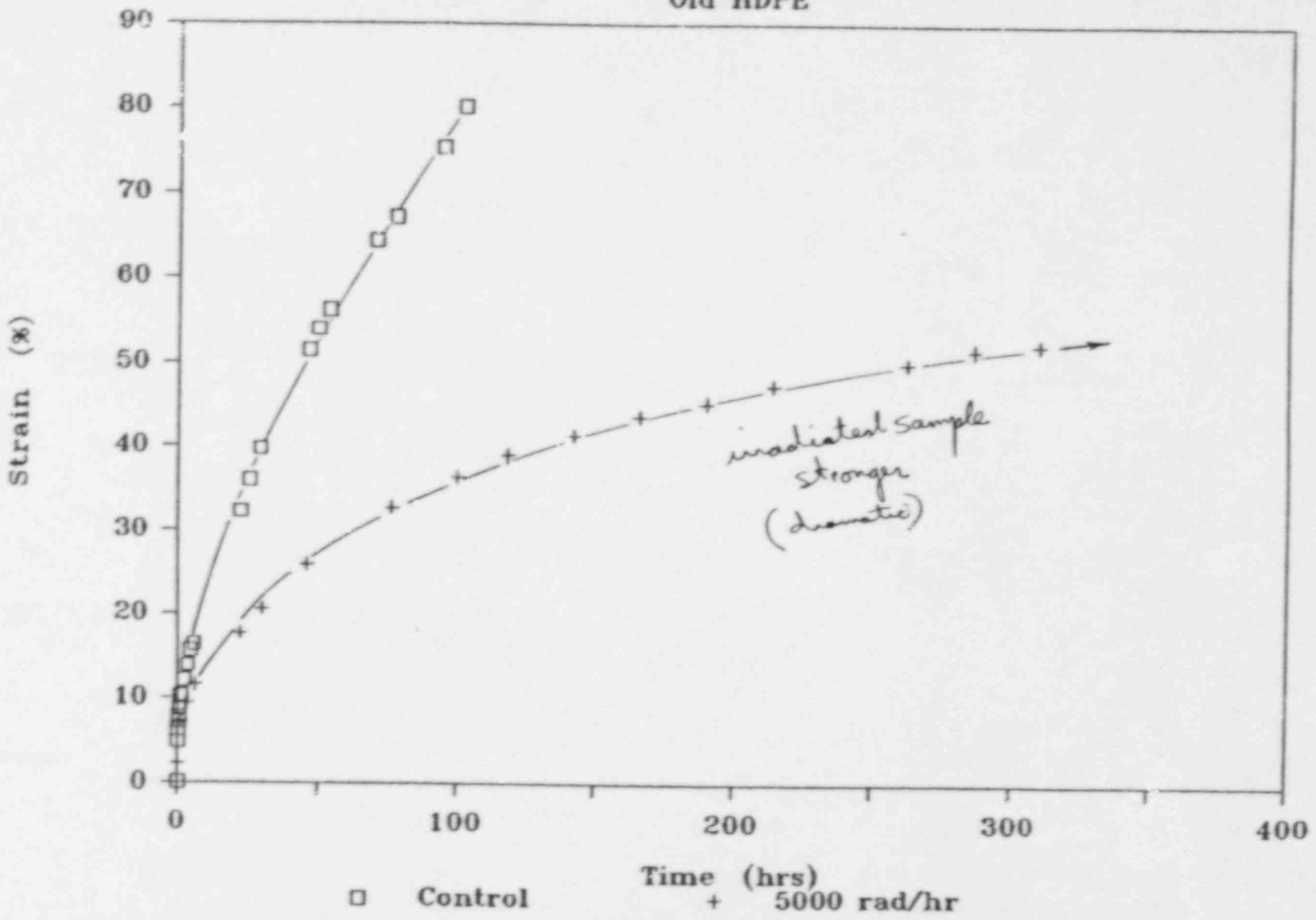
Creep in HDPE Irradiated During Stress



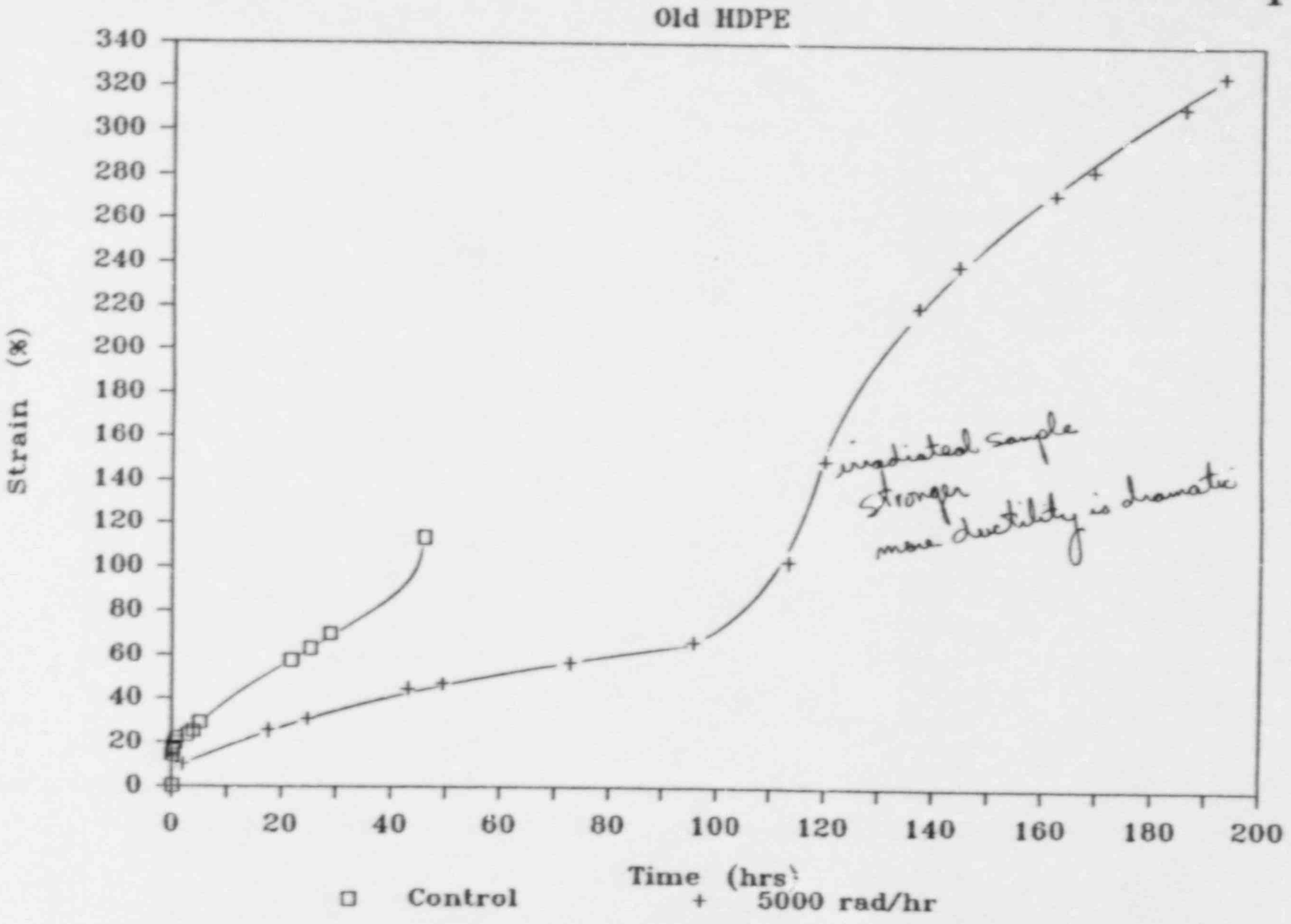
Compare Control and Irradiated 1500 psi



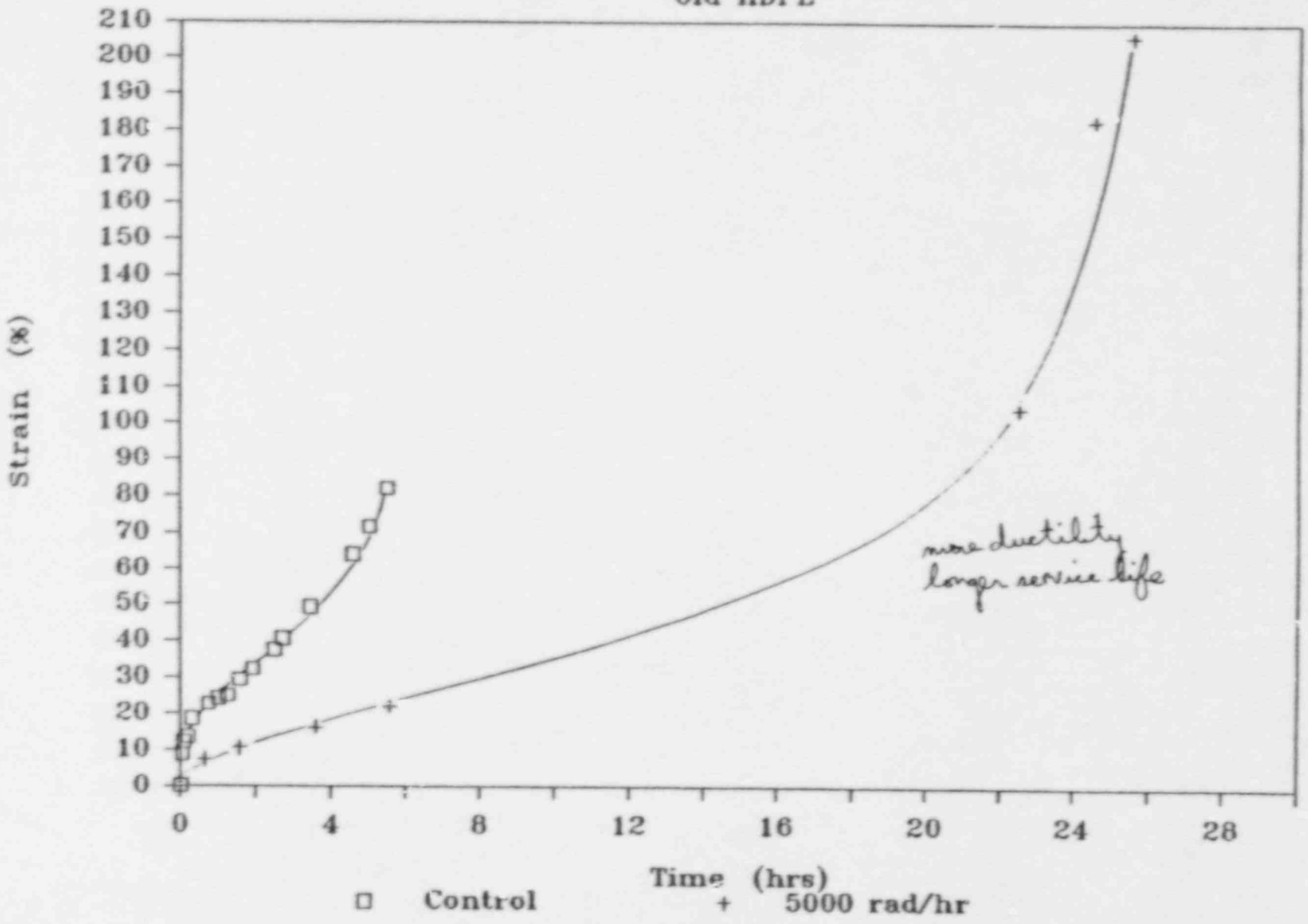
Compare Control and Irradiated 1600 psi



Compare Control and Irradiated 1700 psi



Compare Control & Irradiated 1825 psi



FINDINGS TO DATE ON LOWER DOSE RATE IRRADIATION CREEP TESTS

AT A DOSE RATE OF 5×10^3 RAD/HR :

A) IRRADIATION DECREASES CREEP RATE COMPARED TO UNIRRADIATED CONTROLS AT STRESSES BETWEEN 1500 - 1825 PSI;

B) IRRADIATION AT HIGHER STRESSES INCREASES FAILURE TIME AND ELONGATION. POSSIBLY SAME AT LOWER STRESSES ALSO;

C) THIS BENEFICIAL EFFECT OF GAMMA IRRADIATION CONTRADICTS DOUGHERTY'S EARLIER STUDY.

TESTS WILL SHORTLY START ON HIGHER DOSE RATE CREEP (3×10^4 RAD/HR.).

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SUGGESTIONS FOR FUTURE WORK

1. CONTINUE LOW STRESS CREEP TESTS TO OBTAIN DATA ON THRESHOLD STRESSES AND DUCTILITIES IN VARIOUS CHEMICAL ENVIRONMENTS.

2. CONTINUE LOW STRESS IRRADIATION - CREEP TESTS IN AIR TO DETERMINE CREEP RATES AND DUCTILITIES AT PROTOTYPIC SERVICE STRESSES.

3. CONTINUE EXISTING WORK ON U-BEND SPECIMENS IN CHEMICAL AND IRRADIATION ENVIRONMENTS.

Widmayer

6/27/88

Federal Register Notice

ADVISORY COMMITTEE ON NUCLEAR WASTE
NUCLEAR REGULATORY COMMISSION

Meeting Agenda - Revision 1

The Advisory Committee on Nuclear Waste will hold a meeting on June 27-29, 1988. The sessions on June 27-28, 1988 will be held in Room 1046, 1717 H Street, NW, Washington, DC. The sessions on June 29, 1988 will be held in Room 2F-17, One White Flint North Building, 11555 Rockville Pike, Rockville, MD.

Monday, June 27, 1988 - Room 1046, 1717 H Street, NW, Washington, DC

10:00 A.M. - 10:15 A.M.: Comments by ACNW Chairman (Open) - The ACNW Chairman will report briefly regarding items of current interest.

10:15 A.M. - 12:00 NOON: Design Basis Accident Limits for the HLW Repository (Open) - The DOE Staff will discuss their proposed request for a rulemaking defining the design basis accident limit for the HLW repository.

1:00 P.M - 5:00 P.M.: Licensing of LLW Treatment Processes and the Dry Storage and Consolidation of Spent Fuel (Open) - The NRR Staff will report on the licensing of waste management activities at reactor sites with emphasis on the consolidation of spent fuel, LLW treatment processes, and dry storage.

Tuesday, June 28, 1988 - Room 1046, 1717 H Street, NW, Washington, DC

8:00 A.M. - 10:00 A.M.: LLW Form and Polyethylene High-Integrity Containers (HICs) (Open) - The Division of Low-Level Waste and Decommissioning will report on recent staff and contractor actions concerning LLW solidified by cement, and studies regarding the serviceability of polyethylene HICs. The Division of Regulatory Research will report on the proposed final rule for the revision to 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste".

10:15 A.M. - 12:00 NOON: Consultation Draft Site Characterization Plan (Open) - The DOE Staff will review the content of the CDSCP and describe their plans to address the NRC Staff's comments on it.

1:00 P.M. - 5.00 P.M.: Alternative Site Models of the Yucca Mountain Site (Open) - The DOE Staff and contractors will report on alternative models of the hydrologic structure of the Yucca Mountain site.

B/2

Wednesday, June 29, 1988 - Room 2F-17, 11555 Rockville Pike, Rockville, MD

8:30 A.M. - 10:00 A.M.: ACNW Future Activities and Preparation of ACNW Reports (Open) - The ACNW will meet and continue to discuss anticipated ACNW activities, future meeting agendas, program plans, and organizational matters.

10:00 A.M. - 11:30 A.M.: Meeting with the NRC Commissioners (Open) - The ACNW will meet with the NRC Commissioners to discuss ACNW future activities.

1:00 P.M. - 2:00 P.M.: NRC's Review of DOE's Consultation Draft Site Characterization Plan (Open) - The NRC Staff will discuss their response to the May 11, 1988 memo from R. Fraley to V. Stello on the NRC Staff's review of DOE's Consultation Draft Site Characterization Plan (CDSCP).

2:00 P.M. - 2:30 P.M.: New Members (Closed) - The ACNW will discuss appointments of proposed members and the qualifications of individuals to be considered for nomination.

I have determined in accordance with Subsection 10(d) P.L. 92-463 that it is necessary to close portions of this meeting as noted above to discuss information the release of which would represent a clearly unwarranted invasion of personal privacy [5 U.S.C. 552b(c)(6)] or involve internal personnel rules and practices of the agency [5 U.S.C. 552b(c)(2)].

Procedures for the conduct of and participation in ACNW meetings are similar to those used by ACRS and published in the Federal Register on October 2, 1987 (51 FR 32241). The procedures which will be used are as follows:

BACKGROUND

Procedures to be followed with respect to meetings conducted pursuant to the Federal Advisory Committee Act by the Nuclear Regulatory Commission's Advisory Committee on Nuclear Waste (ACNW) are published in this notice. These procedures are set forth and may be incorporated by reference in future individual meeting notices. The Advisory Committee on Nuclear Waste has been established pursuant to the Federal Advisory Committee Act of October 6, 1972 (P.L. 94-463, 86 Stat. 770-776). The Commission has determined that the establishment of this Committee is necessary and in