To: Robert L. Browning WM 625

AUDIT REPORT

AUDIT TYPE: External

REPORT NO. 85-B-1
DATE OF AUDIT 5/21-23/85

PROJECT NAME: BWIP

ORGANIZATION AUDITED: BWIP Project Office, Richland, Washington

AUDIT TEAM:

C. Newton, HQ-OGR, Team Leader
L. Ibe, Weston, Auditor
E. Sulek, Weston, Auditor
S. Echols, DOE-OGC, Observer
D. Hedges, NRC, Observer

PERSONS CONTACTED (Name and Title)

see attached sheets

Audit Summary and Evaluation

A preaudit meeting was held at 8:00 a.m. on Tuesday, May 21, 1985, to advise BWIP of the purpose and scope of the audit, introduce the audit team, identify project contacts and establish lines of communication. Attendees are identified on the attached attendance sheet. During the meeting BWIP provided a presenta- tion on the project organization and the status of development of the BWIP QA program.

Audit Team Members:

E. W. Sulek 5/23/85
L. D. Ibe 5/23/85

Carl Newton 5-23-85
Audit Team Leader Date

8507080004 850531
PDR WASTE
WM-10 PDR

The purpose of the audit was to assess the status and adequacy of the BWIP QA program and the effectiveness of its implementation. The audit covered BWIP activities falling under the following QA criteria of Appendix B to 10 CFR part 50:

I - Organization
II - Quality Assurance Program
III - Design Control
IV - Procurement Document Control
V - Instructions, Procedures & Drawings
VI - Document Control
VII - Control of Purchased Material, Equipment, and Services
XV - Nonconforming Materials, Parts and Components
XVI - Corrective Action
XVII - Quality Assurance Records
XVIII - Audits

All BWIP and RHO persons contacted during the audit were courteous and professional in their response to the auditors' questions. At the time of the audit the BWIP QA plan, revision 0 had been officially issued as well as five BWIP project management procedures (PMP's) covering the preparation of PMP's and QA audits. An additional PMP covering document control had been drafted and issued for trial use. The remaining PMP's are in various stages of development. Therefore, neither the adequacy of the BWIP QA program nor the effectiveness of its implementation could be fully evaluated at this time.

The audit team observed a number of positive features. Two of these are that BWIP (1) has passed on to its contractors the requirements of the OGR baselined generic requirements document by sending a letter to them and (2) has increased the scope of their auditing program to include the architect engineer, construction manager and two subcontractors. Additionally, BWIP has made considerable progress in the development of methodology for determining items and activities important to safety and to waste isolation.

The major concern of the audit team is that only five of the twenty two identified project management procedures have been issued to date and these essentially cover only QA audits. Emphasis must be given to completing the remaining procedures, conducting the required indoctrination and training, and implementing the program in its entirety in order that site characterization can commence as scheduled. Personnel available to support these QA activities may be insufficient. The number of QA personnel supporting BWIP (approx 1 1/2) are fewer than these supporting the NNWSI project (approx 5) and the SRPO project (approx 3).

Seven findings and two observations were identified during the audit and are attached. These should be taken as being representative of deficiencies observed by the auditors and may not be all inclusive.

The audit team leader briefed the Project Manager on the results of the audit prior to the post audit meeting.

The post audit meeting was held the afternoon of May 23, 1985. Attendees are identified on the attached attendance sheet. The findings and observations were presented and discussed. A copy of the audit report was provided to each attendee.

AUDIT ATTENDANCE SHEET

	DATE	TIME
PRE-AUDIT CONFERENCE ----------	5/21/85	8:00 a.m.

	NAME	ORGANIZATION	TITLE
1.	Gary Bracken	DOE-RL	QA
2.	F. R. Cook	NRC/BWIP Site	On-site Lic. Rep.
3.	Stan Echols	DOE-GC	Attorney
4.	Ted Fitzsimmons	DOE-RL	AMS
5.	Ron Gerton	DOE-RL	SQA Director
6.	Dale Hedges	U.S. NRC	QA Engineer
7.	Lib Ibe	Weston	QA
8.	Mike Karol	DOE-RL	QA Branch Chief
9.	Art Lassila	DOE-RL	BWIPO
10.	Carl Newton	DOE-HQ	QA
11.	Lee Olson	DOE-RL	BWIPO
12.	John Rast	DOE-RL	QA
13.	R. P. Saget	DOE/BWIP	E&C Team Leader
14.	E. W. Sulek	Weston	QA

AUDIT ATTENDANCE SHEET

PERSONNEL CONTACTED DURING AUDIT ---------- DATE May 21-23, 1985

	NAME	ORGANIZATION	TITLE
1.	Al Bell	RL-BWIP	Licensing Coordinator
2.	Gary Bracken	RL-SQA	QA Coordinator
3.	Louie Calloway	RL-Proc.	Contract Specialist
4.	Don Carrell	RHO-BWIP	Staff Engineer
5.	Al Chapman	RL-Proc.	Contract Specialist
6.	Ron Gerton	RL-BWIP	Director, SQA Division
7.	Mike Karol	RL-SQA	Chief, QA Branch
8.	Art Lassila	RL-BWIP	Civil Engineer
9.	Jim Mecca	RL-BWIP	Leader, Licensing Team
10.	Lee Olson	RL-BWIP	Project Manager, BWIP
11.	Ted Petrie	RL-BWIP	Systems Engineer
12.	John Rast	RL-SQA	QA Engineer
13.	Pierre Saget	RL-BWIP	Leader, E&C Team
14.	Tom Tinsley	RL-BWIP	Licensing Engineer
15.	Steve Whitfield	RL-BWIP	Environmental Scientist

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21-23/85

AUDITOR E. W. Sulek/S. F. Echols FINDING NO. 5

FINDING/OBSERVATION DISCUSSED WITH G. Bracken, RL-QA Coordinator
Name Title

SIGNED BY
Name Title Date
(Audited Project Manager)

REQUIREMENT:

Appendix A, Section 4.1 of the NRC QA Review Plan requires procedures to be established for the review of procurement documents by QA personnel to determine that applicable regulatory and other requirements are referenced or stated.

FINDING:

BWIP-RL procedures for procurement document review have not been issued.

COMMENT:

The auditors reviewed SD-BWI-FDC-007 which was issued to RKE/PB on contract DE-AC06-80RL1000 on December 18, 1984. SD-BWI-FDC-007 was found to contain reference to a HQ guidance memorandum which had been rescinded six months earlier. It is recommended that PMP-4.1 be issued and implemented promptly. All contracts should be reviewed to assure that correct QA program requirements have been contractually identified.

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21-23/85

AUDITOR E. W. Sulek/S. F. Echols FINDING NO. 7

FINDING DISCUSSED WITH L. Olson, BWIP, Manager
Name Title

SIGNED BY
Name Title Date
(Audited Project Manager)

REQUIREMENT:

Appendix A, Section 2.1 of the NRC Review Plan requires that items and activities important to safety and waste isolation be identified and the rationale be provided for determining how items and activities are important to safety and waste isolation.

FINDING:

The items important to safety and waste isolation have not been identified by the BWIPO.

AUDITOR RECOMMENDATION/COMMENT:

It is recognized that OGR program wide methodology for generating a "Q" list is being developed jointly by HQ and the projects.

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21/-23/85

AUDITOR E. W. Sulek/S. F. Echols OBSERVATION NO. 1

FINDING DISCUSSED WITH L. Olson/R. Gerton Project Manager/Director SQAD
Name Title

SIGNED BY _____
Name Title Date
(Audited Project Manager)

REQUIREMENT:

Appendix A, Section 1.10a - 1.10e of the NRC QA Review Plan requires the DOE to identify a management position within each organization that retains overall authority and responsibility for the QA program.

OBSERVATION:

Such a position has not been identified within the BWIPO.

AUDITOR RECOMMENDATION/COMMENT:

The Safety and Quality Assurance Division has assigned one full time individual to provide matrix support to the BWIPO and to provide oversight of BWIPO QA activities. A management position for QA program development and implementation should be established within BWIPO. Oversight by the SQA Division then would provide independent verification

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21-23/85

AUDITOR Carl Newton and Lib Ibe FINDING NO. 3

FINDING/OBSERVATION DISCUSSED WITH Gary Bracken, BWIP QA Coordinator
Name Title

SIGNED BY _____
Name Title Date
(Audited Project Manager)

REQUIREMENT:

Section 18.6 of the NRC QA Review Plan requires that:

"A tracking system for audit findings is established to help assure that all findings are appropriately addressed and to trend audit findings."

FINDING:

The required tracking system is not in place. Audit findings to date have not been analyzed for trends. To date, no audit findings have been closed out. Some findings have been outstanding for over a year.

AUDITOR RECOMMENDATION/COMMENT:

Rockwell has established an action plan for closing out all audit findings. A procedure has been issued that, when fully implemented, will include tracking and trending.

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21/-23/85

AUDITOR Carl Newton/E. W. Sulek FINDING NO. 1

FINDING DISCUSSED WITH Pierre Saget, Leader, E&C Team and Gary Bracken, QA Coordinator
Name Title

SIGNED BY _____
Name Title Date
(Audited Project Manager)

REQUIREMENT:

The NRC QA Review Plan requires written procedures to be established for:

	Procedure	Section of Review Plan (Appendix A)
A.	Nonconformances	15.1
	Corrective Action	16.1
	Stop Work	1.12d
	Management Assessment	2.7
	Indoctrination and Training	2.8
	Peer Review	3.8
	Document Control	6.1
B.	Surveillance	1.1
	Design Control	3.3
	Procurement Document Control	4.1
	Document Reviews	7.3
C.	QA Records	17.1

FINDING:

The project has not issued procedures covering these areas.

AUDITOR COMMENT:

Draft procedures under Group A above have been circulated within BWIPO for review/comments.

Procedures under Group B are drafted, but not yet circulated.
Procedures under Group C, i.e., QA records, are not yet drafted.

Comments have been received on the corrective action procedure, and preparation of the final version has been initiated.

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21/-23/8

AUDITOR Carl Newton/Lib Ibe FINDING NO. 4

FINDING DISCUSSED WITH Pierre Saget, Leader, Engineer & Construction Team
Name Title

SIGNED BY _____
Name Title Date
(Audited Project Manager)

REQUIREMENT:

Section 3.3 of the NRC QA Review Plan requires, that: "...organizational responsibilities are described for preparing, reviewing, approving, verifying and validating design and design information documents."

Section 3.6 requires that: "... design drawings, specifications, criteria, and analyses be reviewed by the QA organization..."

FINDING:

Organizational responsibilities for reviewing, approving, and verifying designs are not currently specified in project documents. There are currently no requirements for the BWIP QA organization to be involved in reviewing design drawings and specifications.

AUDITOR COMMENT:

The Project Management Plan and Systems Engineering Management Plan, which are to be issued in the near future, will describe these responsibilities.

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21-23/85

AUDITOR Carl Newton/Lib Ibe FINDING NO. 2

FINDING DISCUSSED WITH Gary Bracken, BWIP QA Coordinator
Name Title

SIGNED BY _____
Name Title Date
(Audited Project Manager)

REQUIREMENT:

Section 18.1 of the NRC QA Review Plan requires that:

"DOE should perform audits of the prime contractor and representative subcontractors, consultants, vendors, and laboratories to assess the effectiveness of the prime contractor's audit program."

FINDING:

To date the Project has not audited representative subcontractors, consultants, vendors, and laboratories of Rockwell as required.

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21-23/85

AUDIT E. W. Sulek/F. S. Echols FINDING NO. 2

FINDING/OBSERVATION DISCUSSED WITH L. Olson (Name) Project Manager (Title)

SIGNED BY _____ Name _____ Title _____ Date
(Audited Project Manager)

REQUIREMENT:

Appendix A. Section 1.6 of the NRC review plan requires clear management controls and effective lines of communication be established for QA activities between DOE and its contractors.

FINDING/OBESERVATION:

While management controls and lines of communication have been established between BWIP and its contractors, addtional clarity should be provided by identifying the controls to be applied defining procedures for their implementation and establishing effective communications channels.

AUDITOR RECOMMENDATION/COMMENT:

The Program Management Plan, Systems Engineering Plan, and Project Management procedures should satisfy this observation when issued and implemented.

AUDIT FINDING REPORT

REPORT NO. 85-B-1
DATE OF AUDIT 5/21-23/85

AUDITOR E. W. Sulek/F. S. Echols FINDING NO. 6

FINDING/OBSERVATION DISCUSSED WITH L. Olson (Name) Project Manager (Title)

SIGNED BY _____ Name _____ Title _____ Date
(Audited Project Manager)

REQUIREMENT:

Appendix A, section 2.4 of the NRC QA Review Plan requires the QA organization to first review and then to document their concurrence with the "quality-related* procedures relative to quality requirements."

*"Quality-related" refers to the quality of items important to safety or important to waste isolation.

FINDING:

BWIP's requirements for review and concurrence with contractor's procedures for items or activities important to safety or to waste isolation are not defined.

AUDITOR RECOMMENDATION/COMMENT:

The auditors were advised that the project management plan, systems engineering, management plan and project management procedures will identify the contractors documents to be submitted for BWIP review and will assign responsibilities and define methods for conducting the review.

To: Robert E. Browning MS 623 SS

AGENDA

BASALT WASTE ISOLATION PROJECT
BRIEFING FOR
OFFICE OF INSPECTOR GENERAL

Richland, Washington
June 5-6, 1985

Room 780, Federal Building
June 5, 1985

1:45 p.m.	Introductions	R. P. Saget
1:55	Objective of IG Visit	R. McKim Capitol Reg. A. W. Heinlein Westinghouse
2:10	Mission of the OCRWM Program	R. P. Saget
2:20	History of the Waste Disposal Program	D. J. Squires
2:30	BWIP Mission	D. J. Squires
2:35	BWIP Project Phases and Project Objectives	R. P. Saget
	PROJECT MANAGEMENT	
2:45	Project Organization and Functional Relationships	R. P. Saget
3:10	Project Management o Policy o Baselines Management - Cost - Schedule - Technical - Funds	E. W. Higgins Rockwell
3:30	BWIP Budgets	J. D. Kirk
3:40	Fund Management	J. D. Kirk
3:50	Systems Engineering o SEMP o Hierarchy Documentation	E. H. Petrie

Selected
view graphs from
I.G presentation
on 6/5 & 6/6

TRC.

4:05	Contractors History:	
	o Rockwell	R. P. Saget
	o RKE/PB	B. L. Nicoll
	o M-K	R. D. Hudson
	o Other Contractors (Listing)	D. J. Squires

QUALITY ASSURANCE

4:30	BWIP Quality Assurance	G. J. Bracken
5:15	Adjourn	

Room 686, Federal Building
June 6, 1985

TECHNICAL MANAGEMENT

8:30 a.m.	Geology	B. W. Hurley
8:40	Hydrology	K. M. Thompson
8:50	Geochemistry	M. J. Furman
9:00	Waste Package	P. E. LaMont
9:20	Drilling Activities	A. G. Lassila
9:30	Performance Assessment	A. J. Knepp
9:40	Repository Design and Construction	B. L. Nicoll
10:05	ES Design and Construction	R. D. Hudson
10:15	ES and NSTF Testing	P. L. Boileau
10:25	Land Acquisition	R. P. Saget
10:40	Licensing Requirements	J. E. Mecca
11:00	SCR	J. E. Mecca
11:10	SCP	J. M. Kovacs

11:20	BWIP Environmental Program Activities	S. C. Whitfield
12:00 noon	Lunch	
	PROJECT INTERACTIONS	
1:00 p.m.	NRC	J. E. Mecca
1:15	EPA	J. E. Mecca
1:25	USGS	A. G. Lassila
1:35	MSHA/U. S. Bureau of Mines	R. P. Saget
1:45	States and Indian Tribes	C. T. Tinsley
2:15	The public, media and special interest gtoups	M. Talbot
2:45	Other Activities	J. E. Mecca
	o C&C Agreements	
3:00	MRS	R. B. Goranson

Wwpa
MES
Spent Fuel
Matrix
36
42
7P
86

BWIPO DIRECT STAFFING IN FY 1985

1986 30 people proj.

PROJECT MANAGER'S OFFICE (5)

O.L. OLSON - PROJECT MANAGER
D.J. SQUIRES - PROGRAM ANALYST
M.B. VALE - SECRETARY
G.J. BRACKEN - QUALITY ASSURANCE
E.W. HIGGINS - COST CONTROL ANALYST

LICENSING TEAM (6)

J.E. MECCA - TEAM LEADER
S.C. WHITFIELD - ENVIRONMENTAL SCIENTIST
A.J. BELL - LICENSING COORDINATOR
J.M. KOVACS - LICENSING ENGINEER (NRC)
C.T. TINSLEY - LICENSING ENGINEER (STATE/INDIANS)
VACANT - SECRETARY

ENGINEERING & CONSTRUCTION TEAM (6)

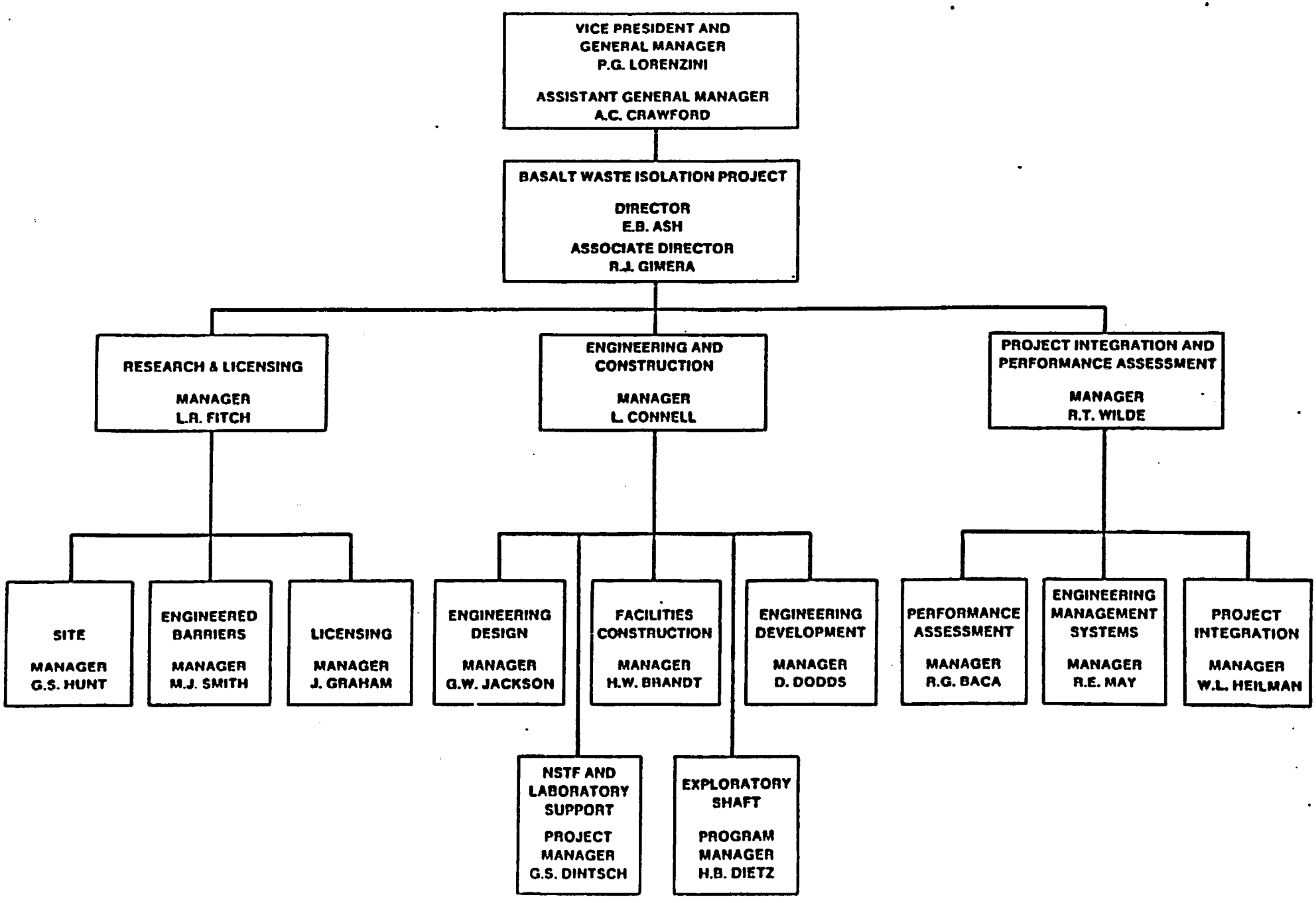
R.P. SAGET - TEAM LEADER
R.D. HUDSON - PROJECT ENGINEER
B.L. NICOLL - PROJECT ENGINEER
P.L. BOILEAU - MINING ENGINEER
E.H. PETRIE - SYSTEMS ENGINEER
I.E. HICKMAN - SECRETARY

GEOSCIENCE & TECHNOLOGY TEAM (8)

D.H. DAHLEM - TEAM LEADER
P.E. LAMONT - CHEMICAL ENGINEER
A.G. LASSILA - CIVIL ENGINEER (GEOLOGIST)
M.J. FURMAN - GEOCHEMIST
K.M. THOMPSON - HYDROLOGIST
B.W. HURLEY - STRUCTURAL GEOLOGIST
A.J. KNEPP - HYDROLOGIST (MODELING)
S.R. THURMOND - SECRETARY

FY85 = 500 includes [illegible]
FY86 618 ✓

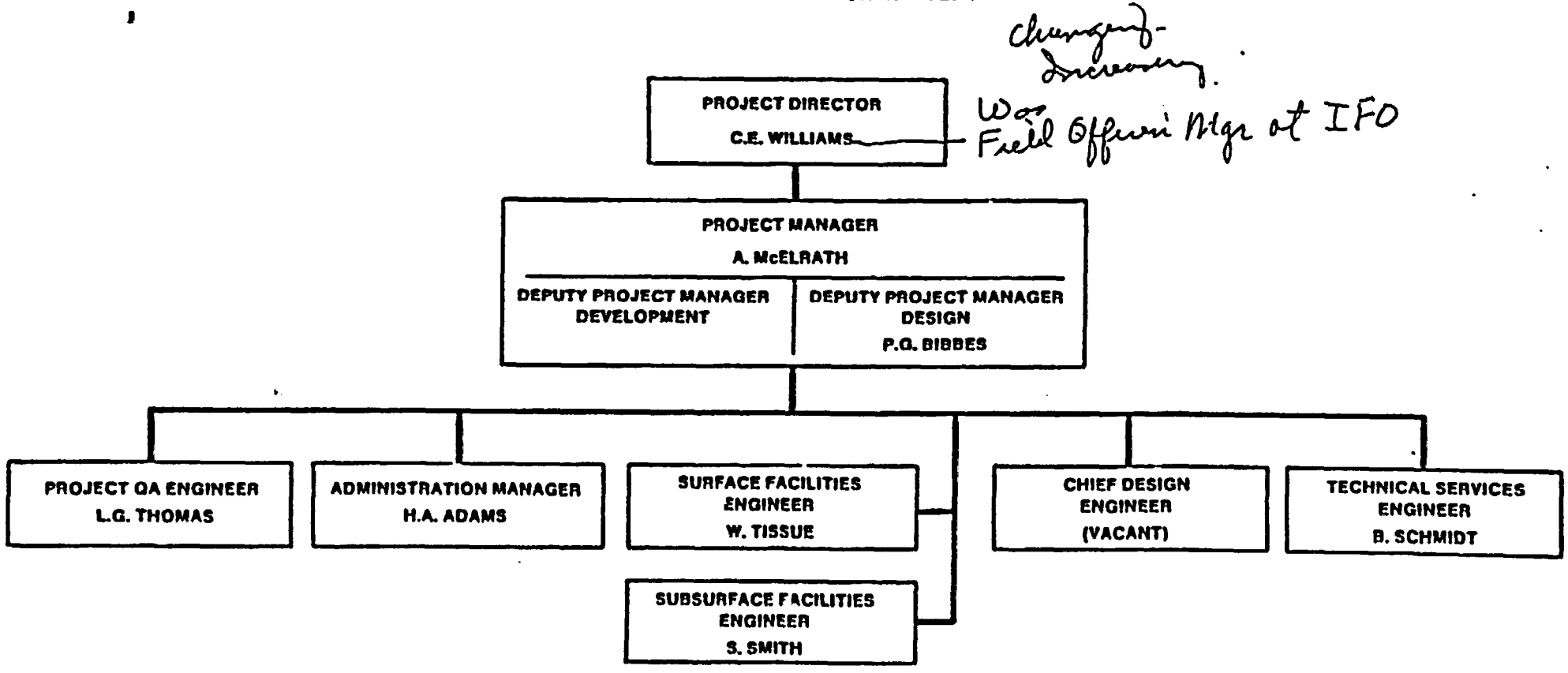
ROCKWELL HANFORD OPERATIONS
BWIP ORGANIZATION CHART



6 → 40 people

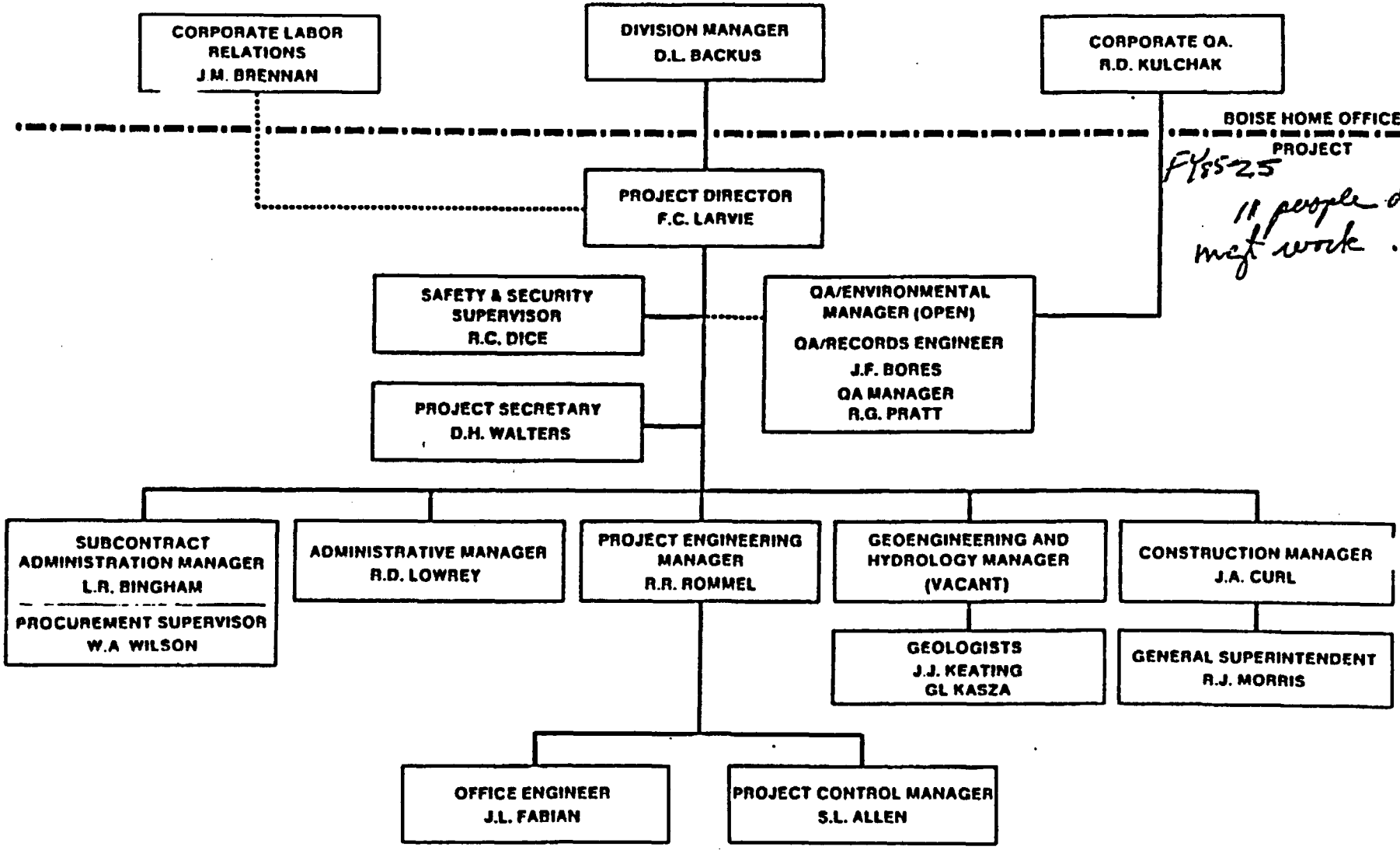
RAYMOND KAISER ENGINEERS PARSONS BRINKERHOFF QUADE & DOUGLAS, INC.

RKE/PB BWIP ORGANIZATION



MORRISON-KNUDSEN COMPANY, INC.

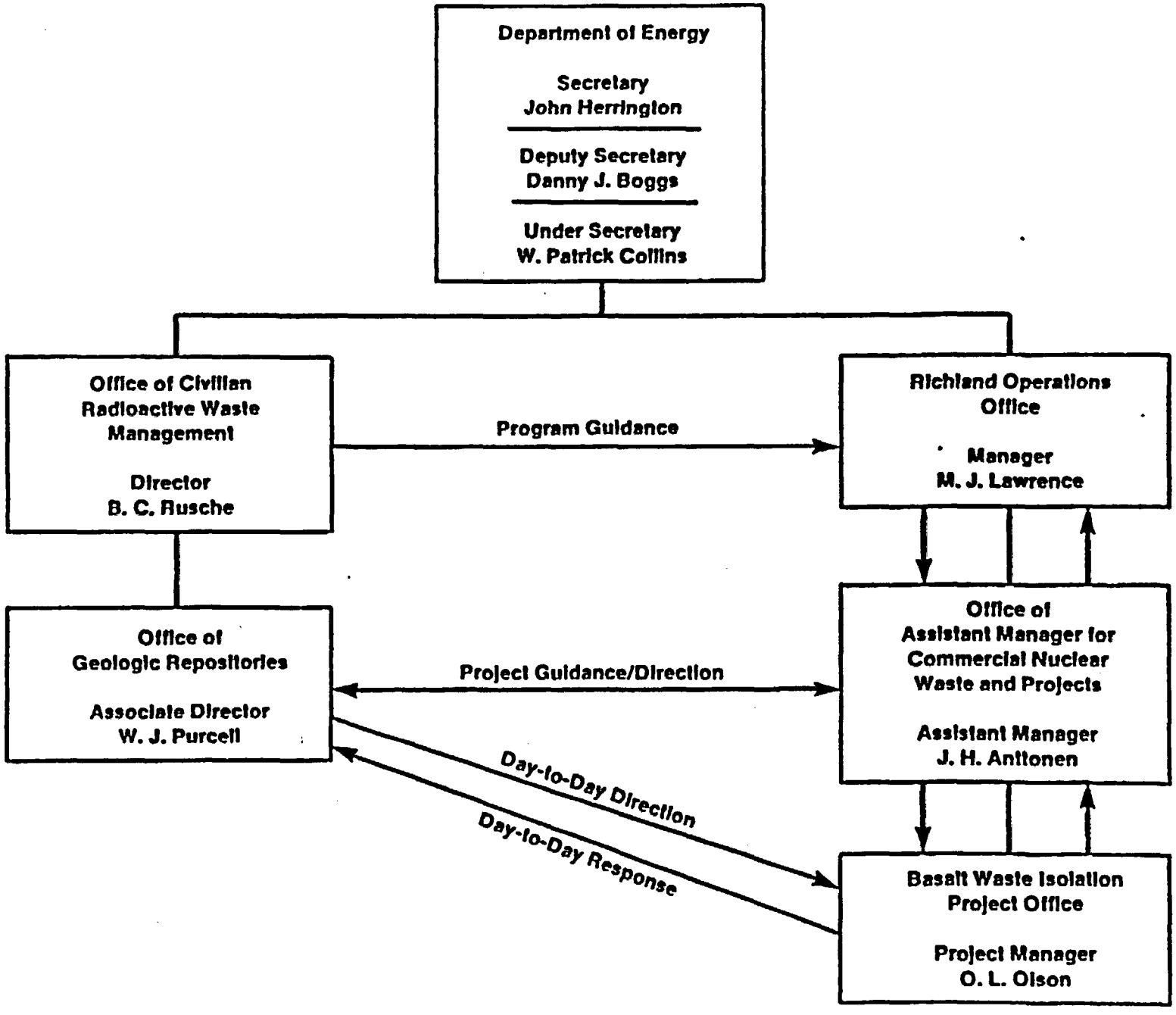
M-K BWIP ORGANIZATION



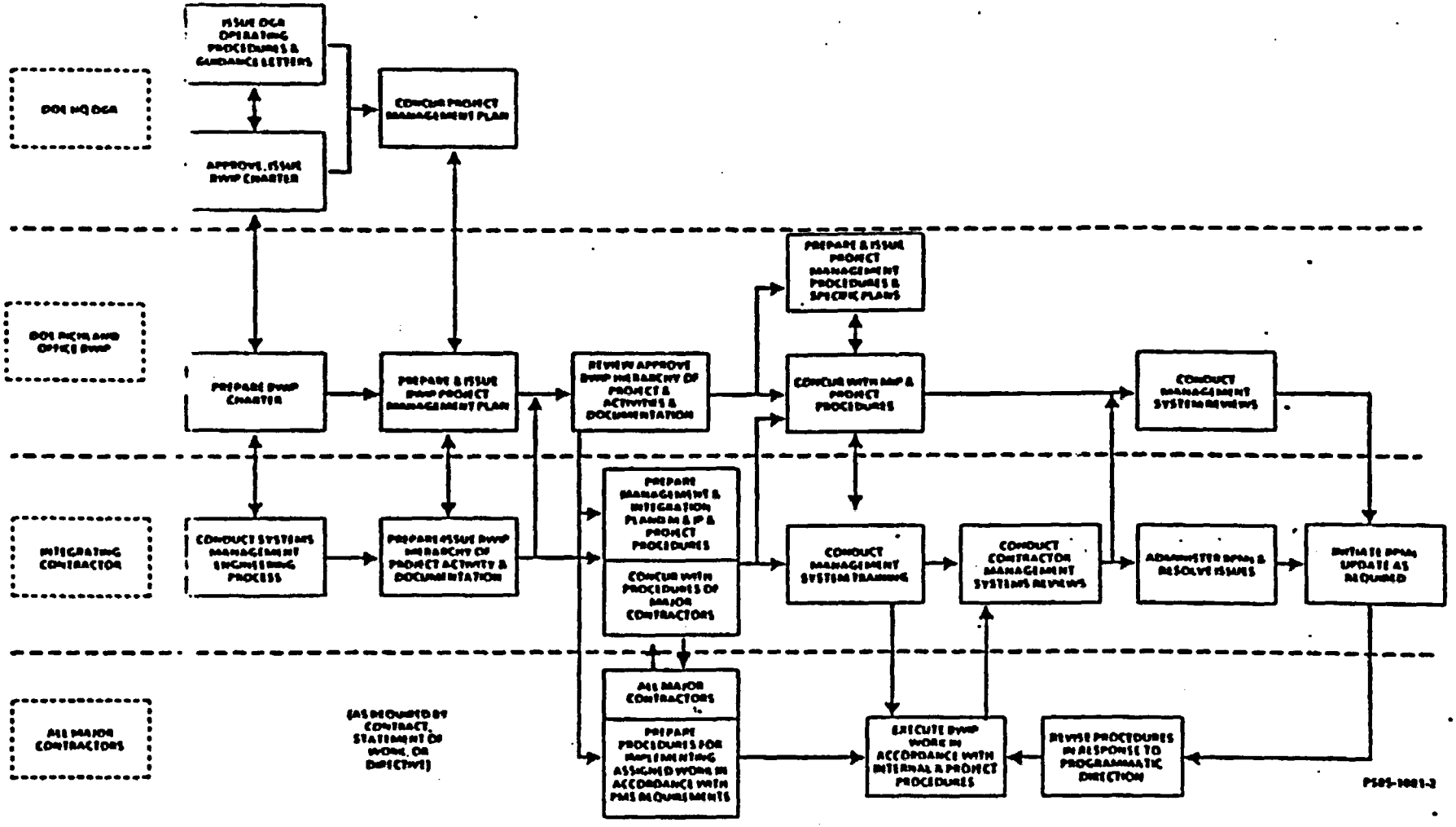
FY85-25

11 people doing'ani mgt work.

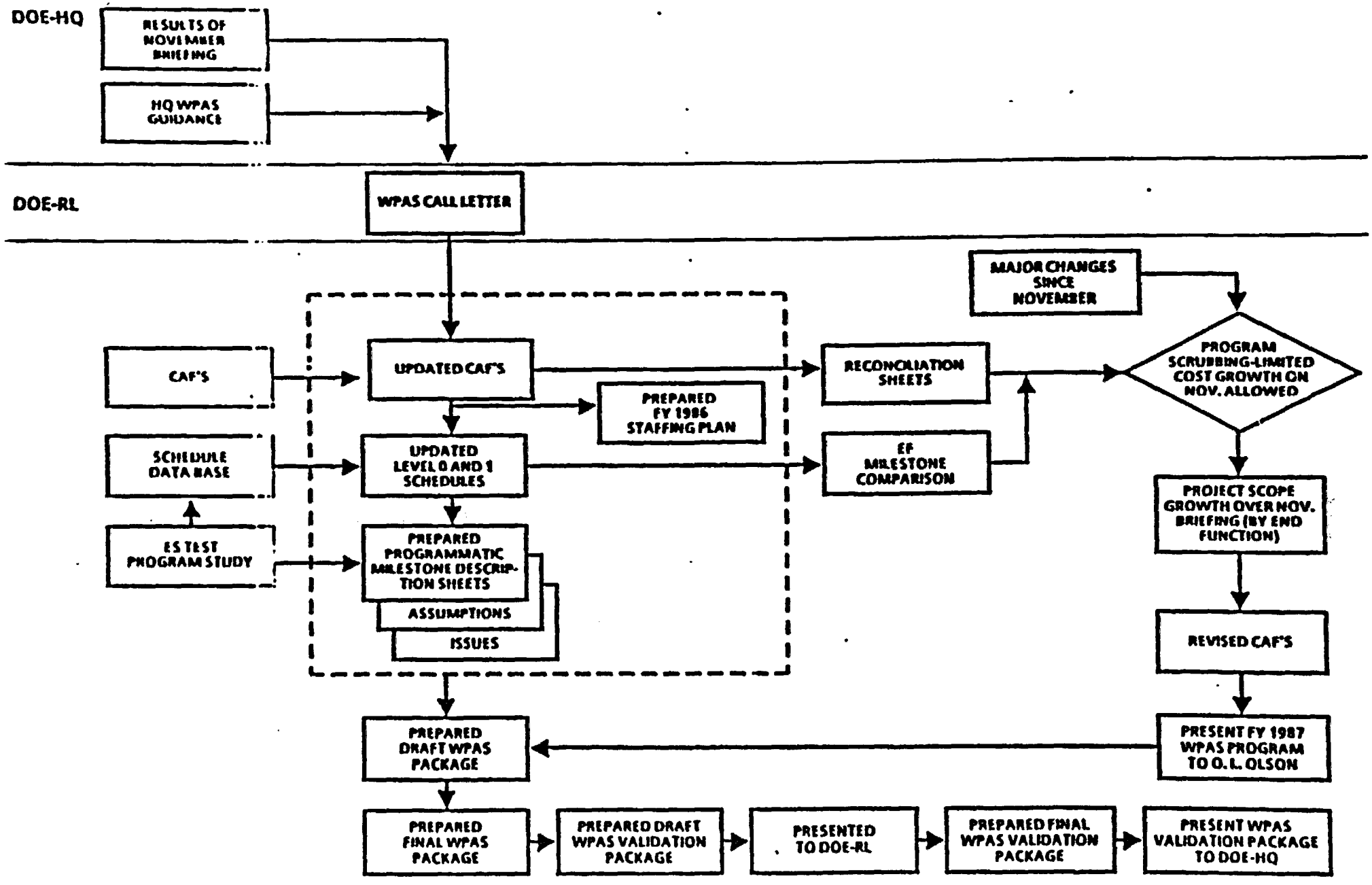
LINES OF AUTHORITY



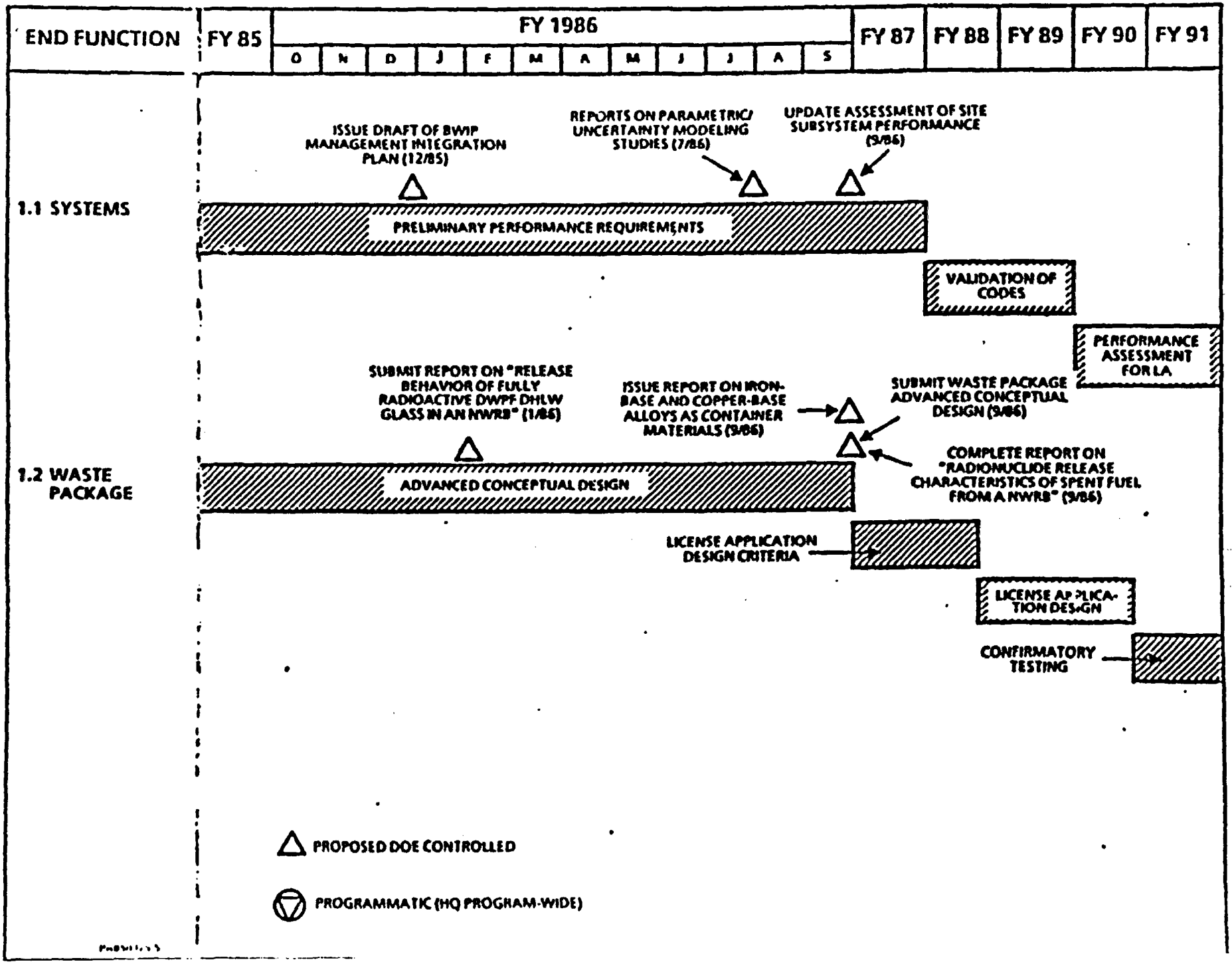
BWIP MANAGEMENT SYSTEM IMPLEMENTATION PROCESS



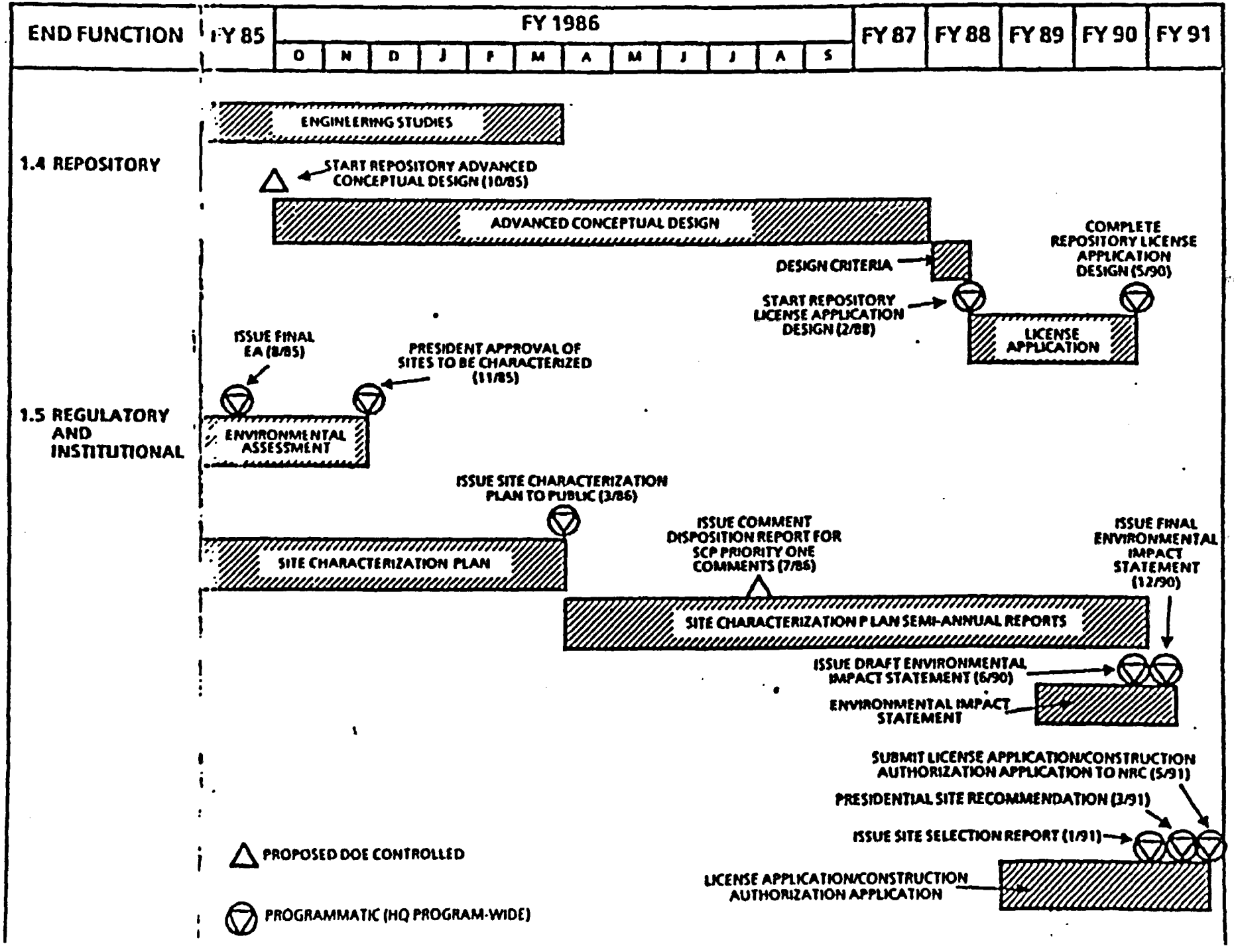
WPAS PREPARATION PROCESS



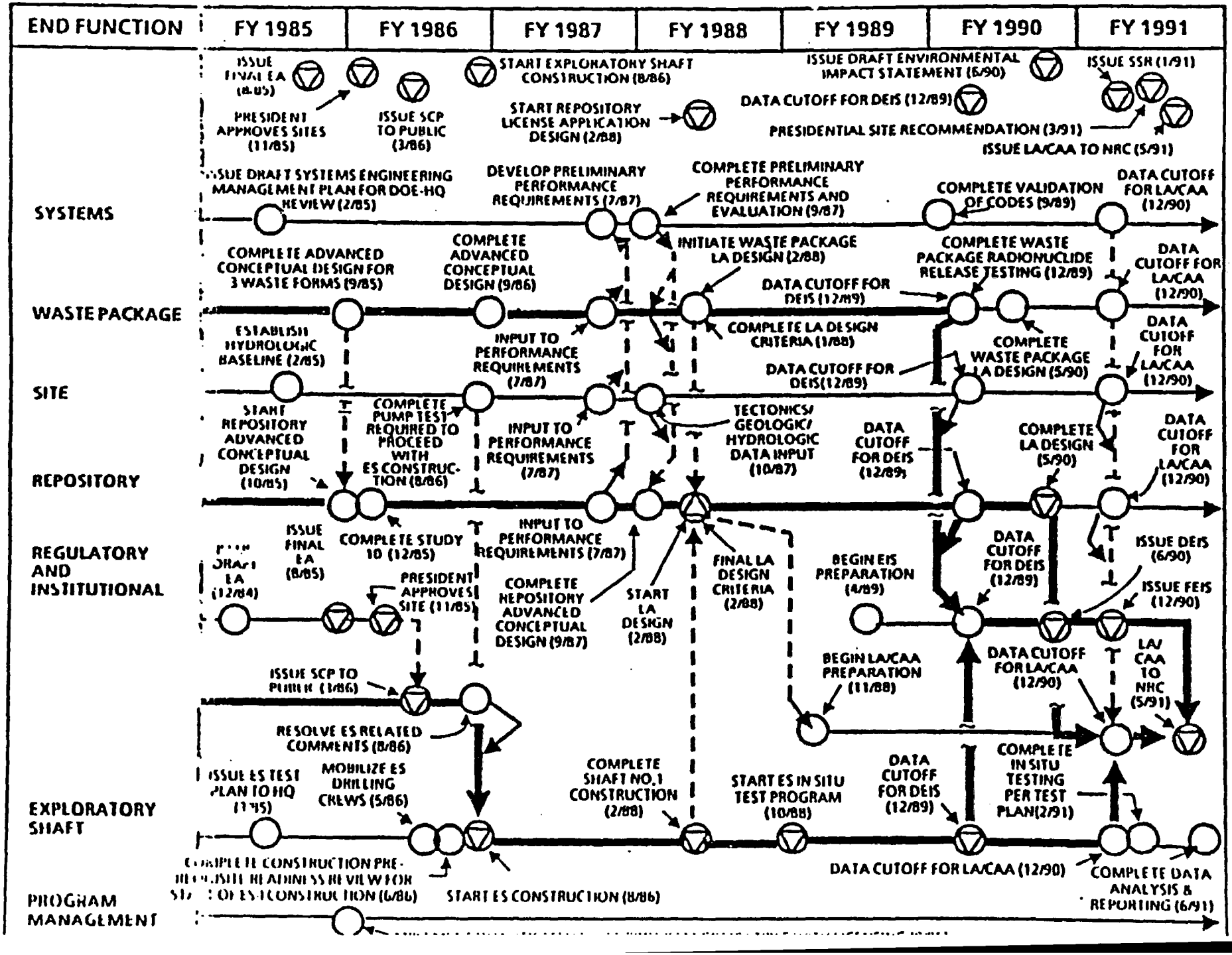
FY 1986 SCHEDULE WINDOW — WPAS REFERENCE CASE



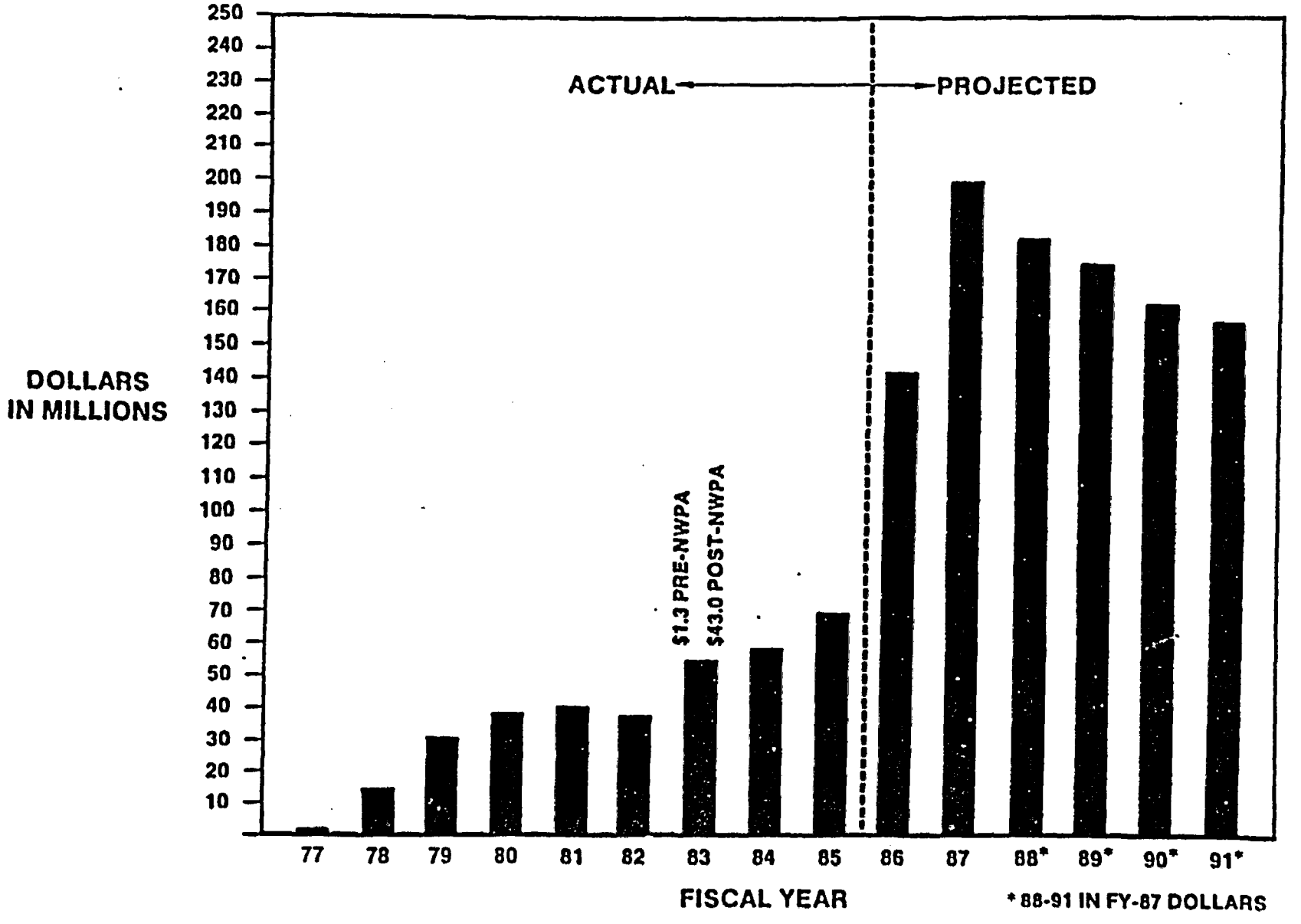
FY 1986 SCHEDULE WINDOW WPAS REFERENCE CASE



BWIP SUMMARY SCHEDULE – WPAS REFERENCE CASE

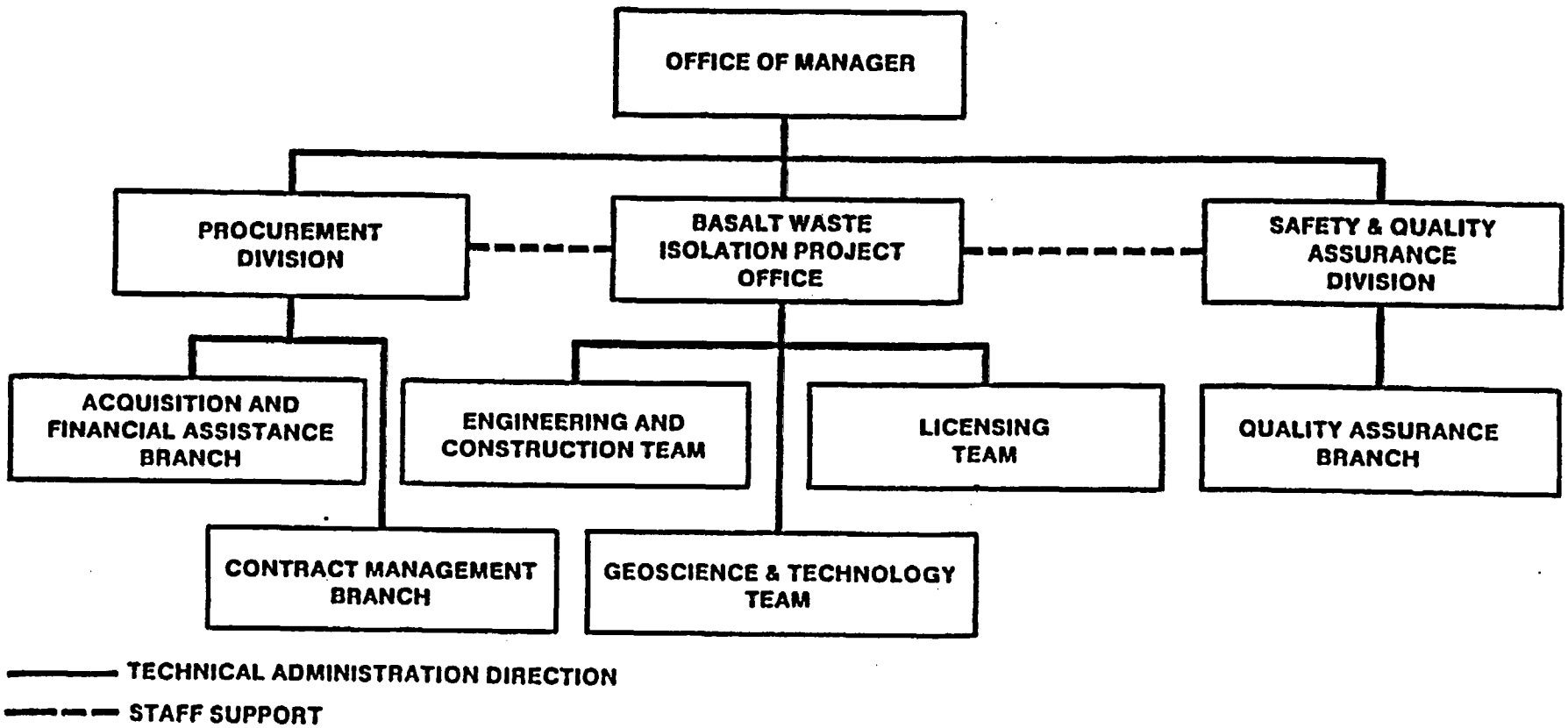


BWIP ACTUAL AND PROJECTED ANNUAL FUNDING

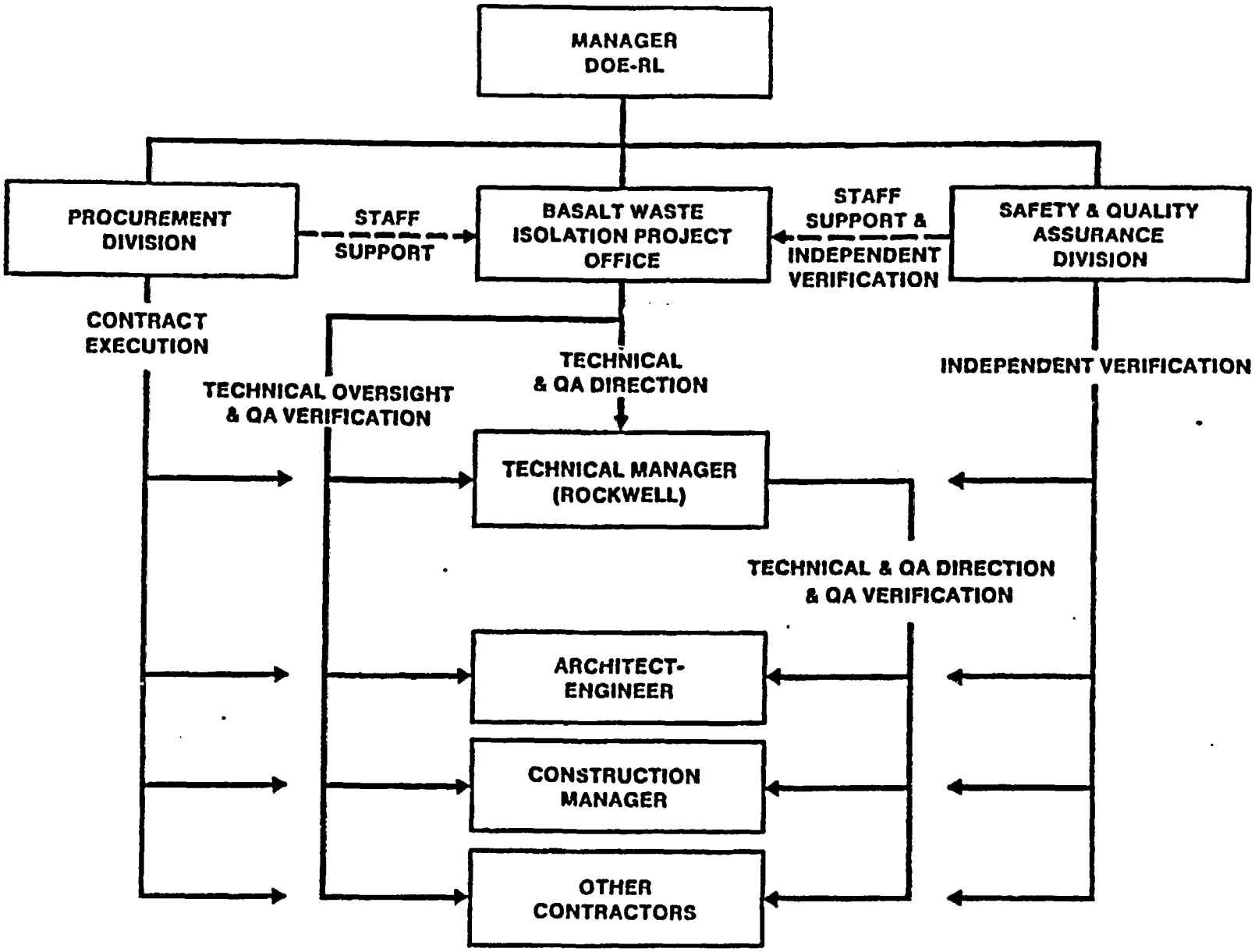


BASALT WASTE ISOLATION PROJECT ORGANIZATION

RICHLAND OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

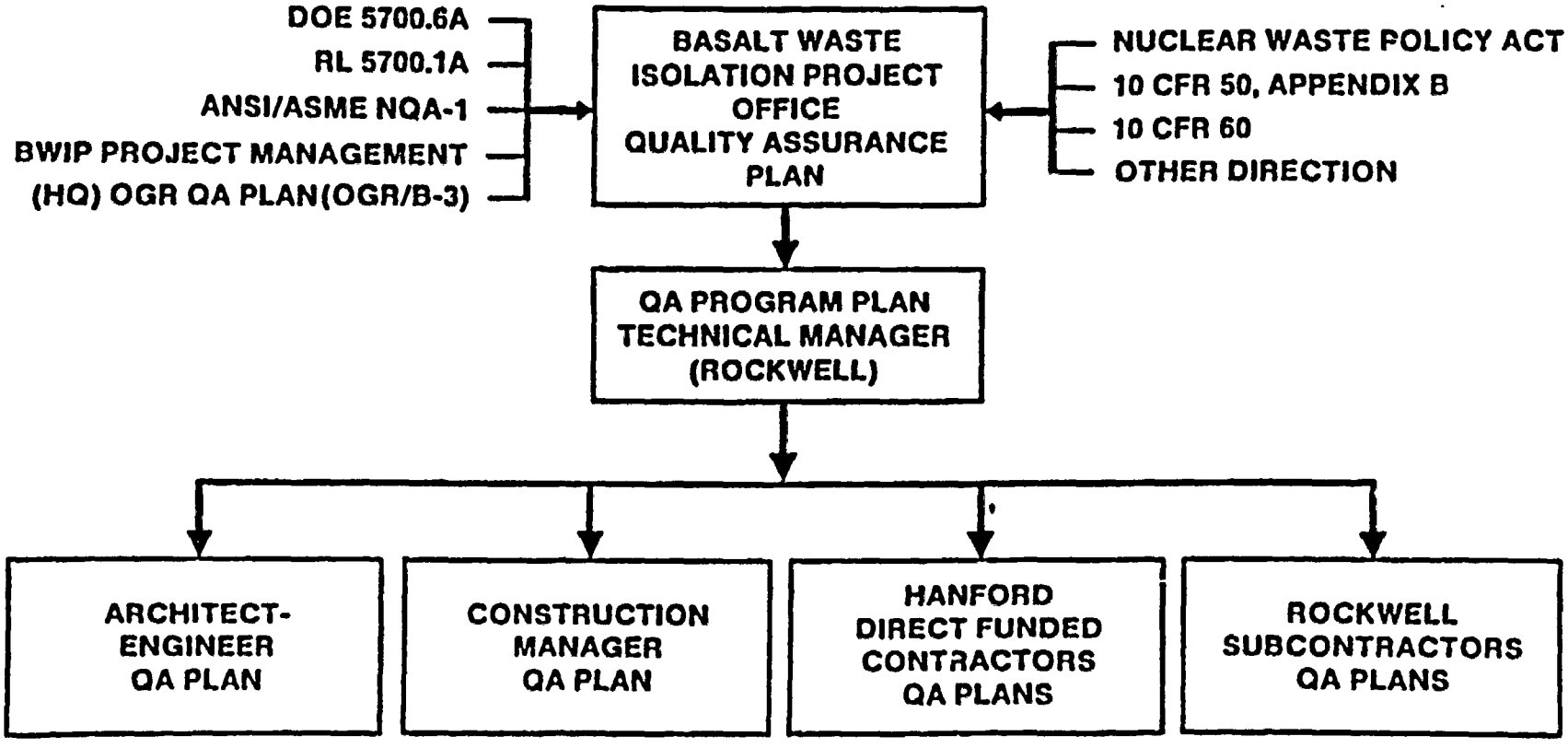


BASALT WASTE ISOLATION PROJECT
ORGANIZATION

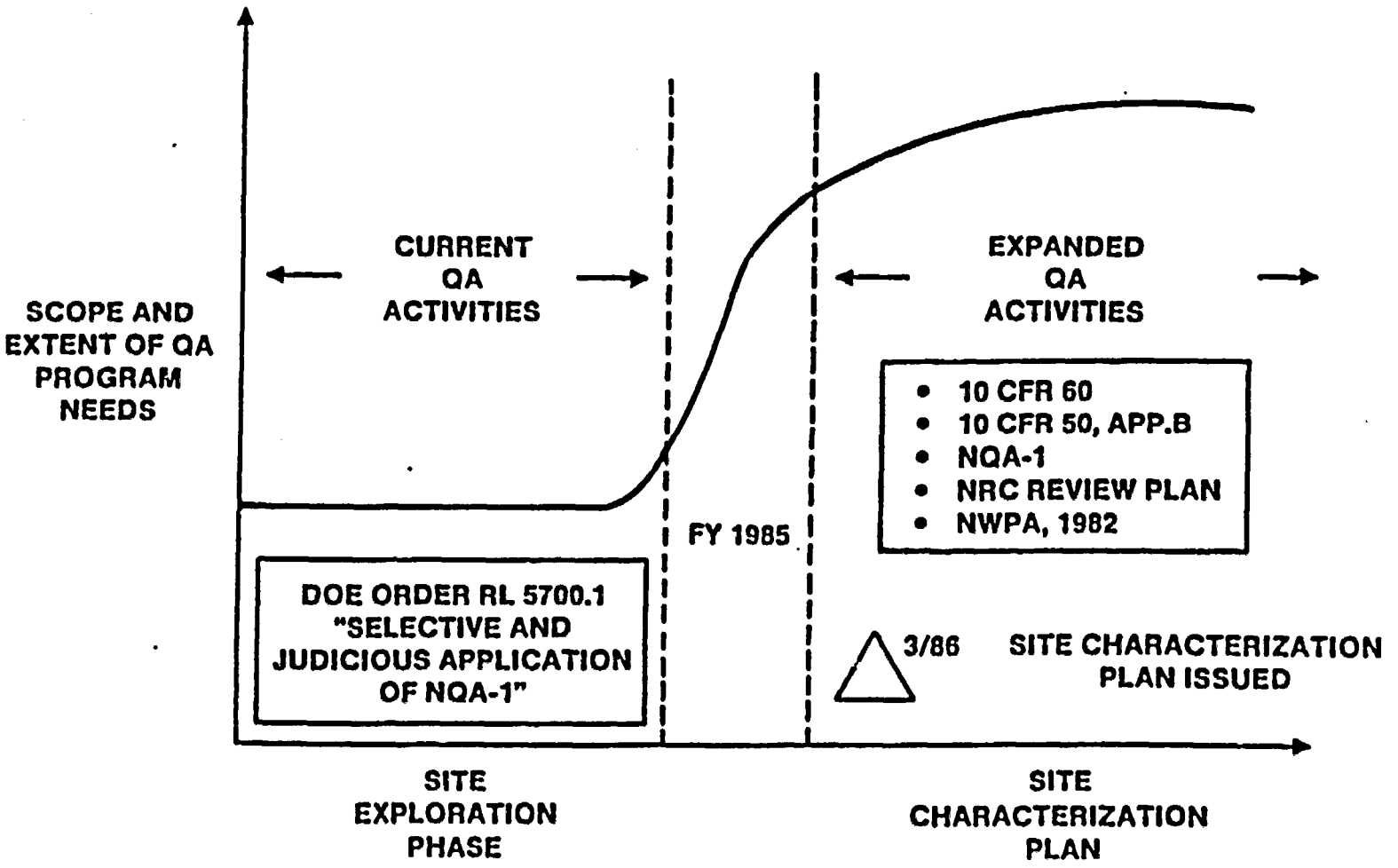


BASALT WASTE ISOLATION PROJECT

ORGANIZATIONAL POLICIES AND REQUIREMENTS



GROWTH IN QA NEEDS

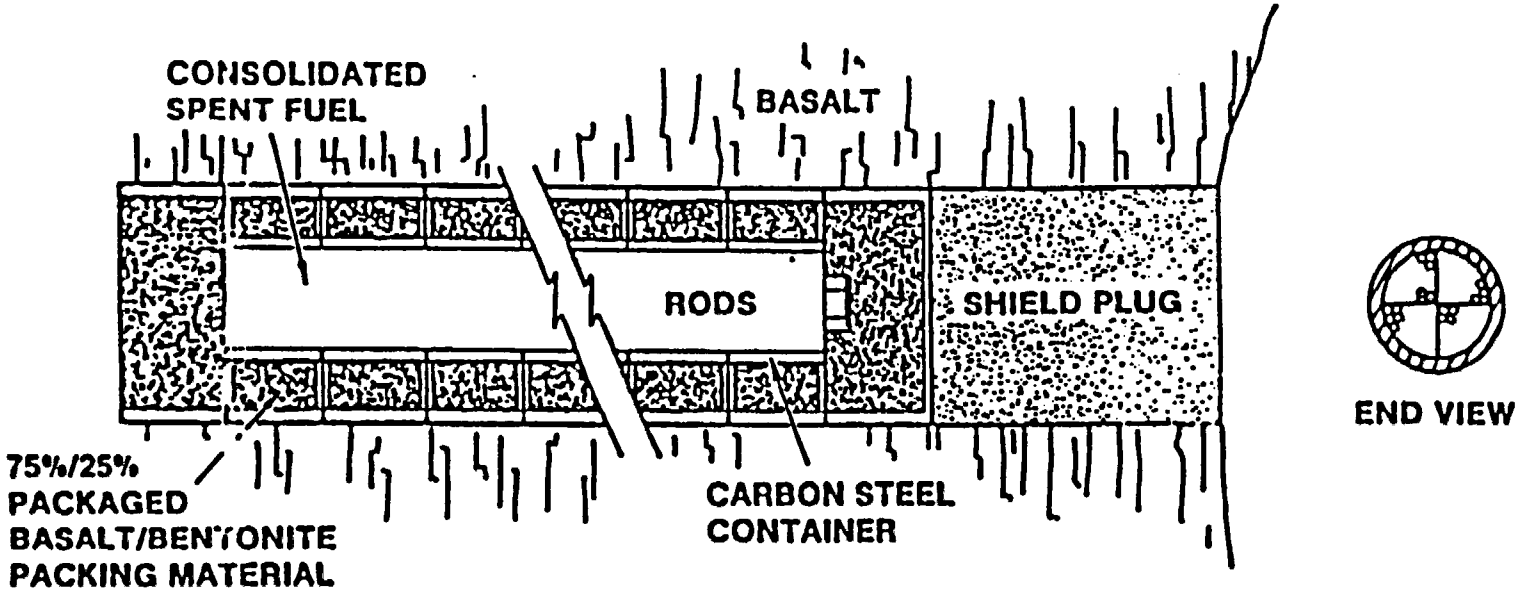


BASALT WASTE ISOLATION PROJECT OFFICE
QUALITY ASSURANCE PROGRAM
ISSUES AND ACTIONS

Need qualified people in those areas

ISSUE	ACTION
Use of QA contractors can lead to lack of QA program continuity.	None required - no significant QA contractors hired to date.
NRC involvement in DOE readiness reviews.	BWIP planning for Exploratory Shaft readiness review includes NRC involvement.
Effectiveness and compliance of participant QA programs.	Continue Project Office audit/followup actions.
Line responsibility for QA vs. effectiveness of independent QA organization.	Project Office QA Plan describes a split of responsibilities between SQA and Project Office.
Need for more trend analysis.	Being evaluated in context of October 1985 implementation for Project Office QA program.
USGS acceptance of BWIP QA requirements.	USGS to continue limited work pending resolution following establishment of project Q-list.
NRC consultant suggestions for design reviews and central problem reporting.	Meeting established for July with NRC and consultant to discuss.

BWIP CONSOLIDATED SPENT FUEL REFERENCE WASTE PACKAGE CONCEPT



WASTE TYPE	CARBON STEEL CONTAINER (ASTM A-27)			BASALT BENTONITE PACKING MATERIAL	BOREHOLE DIMENSIONS		EMPLACEMENT PACKAGE WEIGHT (POUNDS)
	OD	WALL	LENGTH	THICKNESS	ID	LENGTH	
SPENT FUEL (4 PWRS)	19.4	3.1	159	6	32.5	193	13,500

(ALL DIMENSIONS IN INCHES)

WP8411-122

FUNCTIONAL REQUIREMENTS OF THE CONTAINER COMPONENT

- TO PROVIDE RADIONUCLIDE CONTAINMENT DURING SHIPPING, HANDLING, AND POSSIBLY RETRIEVAL
- TO PROVIDE RADIONUCLIDE CONTAINMENT FOR UP TO 1,000 YR AFTER EMPLACEMENT
- TO PROVIDE SUFFICIENT SHIELDING TO PREVENT SIGNIFICANT GROUNDWATER RADIOLYSIS

FUNCTIONAL REQUIREMENTS OF THE PACKING MATERIAL COMPONENT

- MINIMIZE CONTAINER CORROSION DURING THE CONTAINMENT PERIOD (UP TO 1,000 YR)
- PREVENT RADIONUCLIDE TRANSPORT INTO THE HOST ROCK DURING THE CONTAINMENT PERIOD IN THE EVENT OF PREMATURE CONTAINER BREAKTHROUGH AND WASTE FORM DISSOLUTION
- REDUCE THE RADIONUCLIDE RELEASE RATE TO THE HOST ROCK AFTER THE CONTAINMENT PERIOD
- <u>MECHANISMS</u>
  - RETARD DIFFUSION OF RADIONUCLIDES
  - DELAY WATER CONTACT WITH THE CONTAINER
  - MINIMIZE GROUNDWATER FLUX PAST THE CONTAINER
  - BUFFER OXYGEN CONTENT NEAR THE CONTAINER
  - LOCALIZE CORROSION PRODUCTS AT THE PACKING MATERIAL/CONTAINER INTERFACE

WASTE PACKAGE
CURRENT ACTIVITIES

MANAGEMENT AND INTEGRATION

- o Site Characterization Report (Geochemistry and Waste Package Chapters, Waste Package Plans)
- o Environmental Assessment (Geochemistry Issues)

WASTE PACKAGE ENVIRONMENT

- o Radiolysis Studies (gamma and alpha)
- o Basalt - Groundwater Interactions
- o Icelandic Analog Studies
- o Redox Stujies

WASTE FORM AND MATERIALS TESTING

- o Waste Acceptance Requirements/Test Material Specifications
- o Container Material Tests (Iron- and Copper-base Materials)
- o Waste-Barrier-Rock Tests (Irradiated Spent Fuel, Defense Waste Glass, Tracer-Tests)
- o Packing Material Tests (Physical and Chemical Property Tests)
- o Developmental Tests (Eh-pH Probes, Parr Vessels)

DESIGN, FABRICATION, AND PROTOTYPE TESTING

- o Advanced Conceptual Design Requirements
- o Advanced Conceptual Design (SF and WVHLW Forms, Iron- and Copper-base Containers)
- o Container Structural Design Criteria
- o Pre-fabricated Packing Development Tests

WASTE PACKAGE PERFORMANCE ASSESSMENT

- o Performance and Reliability Analysis

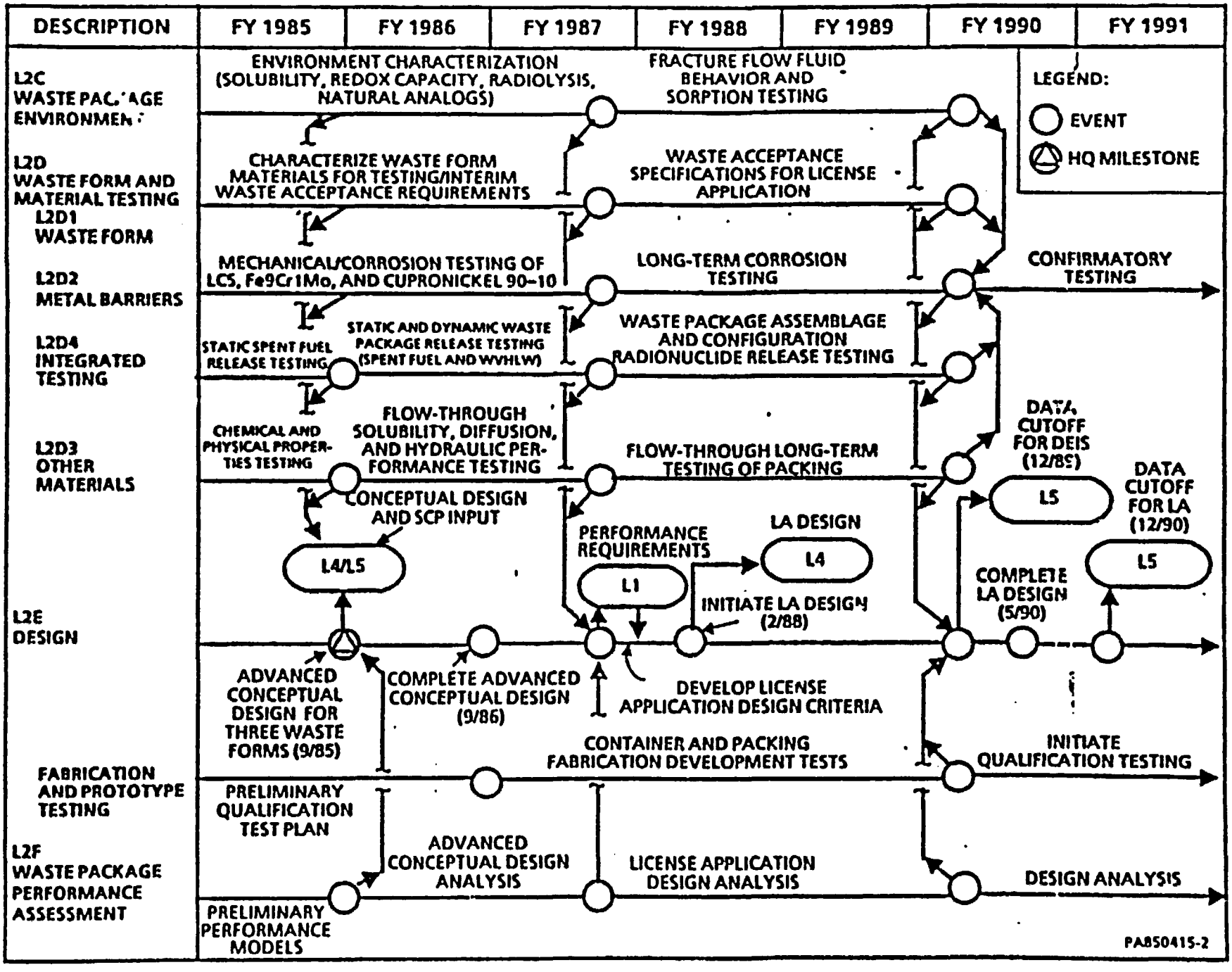
WASTE PACKAGE

FY 1985 MAJOR MILESTONES

12/84	Submit Advanced Conceptual Design Criteria
7/85	Submit Progress Report on Copper-Based Container Materials Testing
9/85	Submit Waste Package Advanced Conceptual Design Report for Three Waste Forms
9/85	Submit Waste Package Preliminary Reliability Analysis

MASTER PROJECT SCHEDULE

1.2 WASTE PACKAGE



BWIP PROBABILISTIC PERFORMANCE ANALYSIS APPROACH

MODEL INPUTS

- CERTAIN DATA
- UNCERTAIN DATA (e.g., PERMEABILITY, SOLUBILITY)

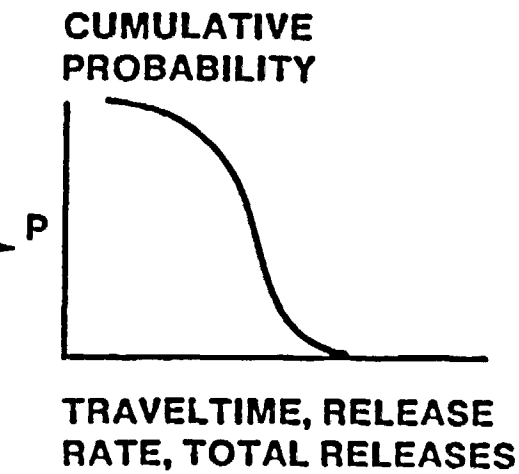
→

PROBABILISITIC MODEL

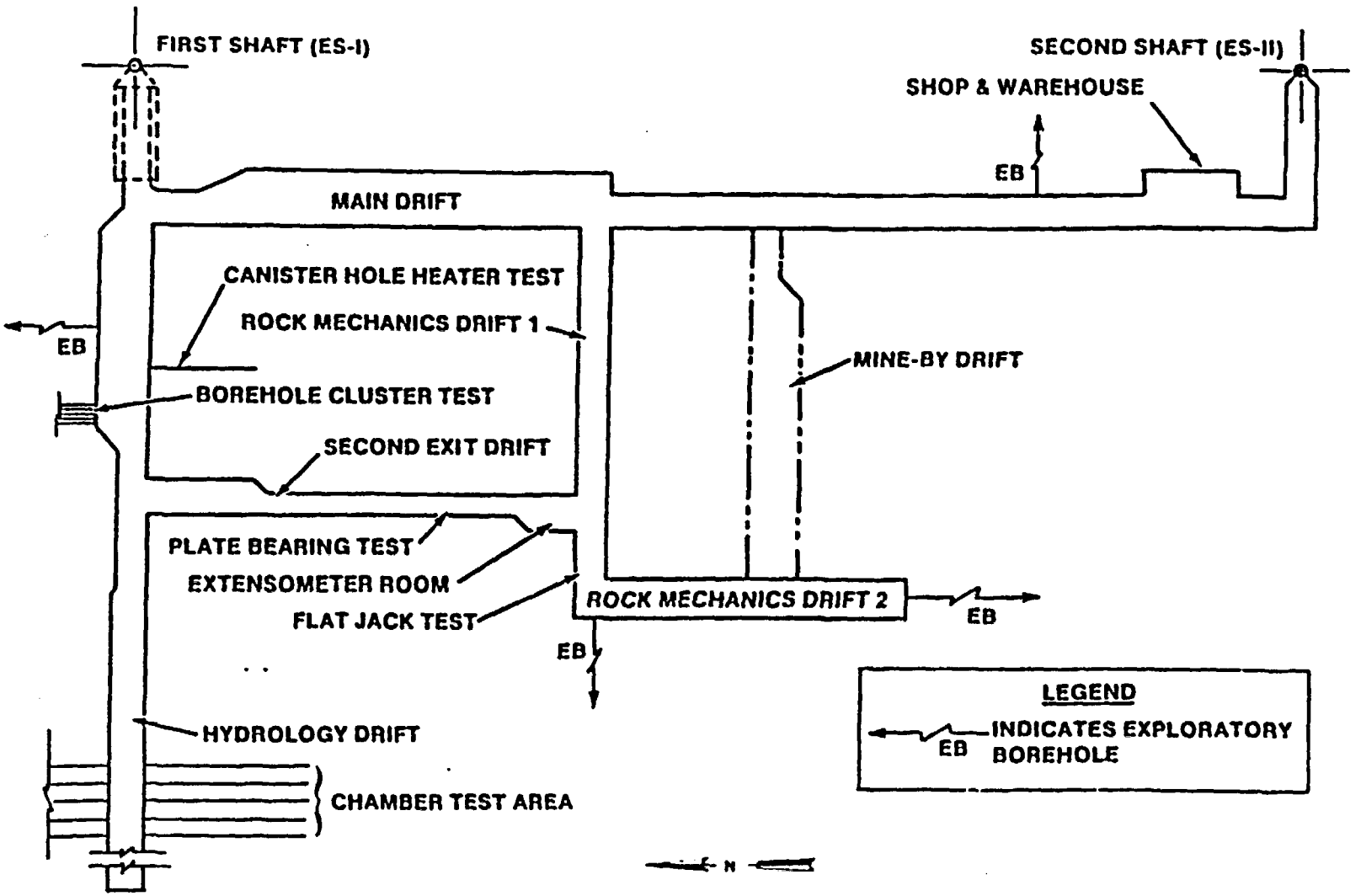
- MONTE CARLO TECHNIQUE

  (i.e., STATISTICAL SAMPLING METHOD)

→



EXPLORATORY SHAFT - PHASE II ARRANGEMENTS (2 SHAFTS)



ROCKWELL ENGINEERING DEVELOPMENT DEPARTMENT

CURRENT ACTIVITIES:

- o Selection and evaluation of various computer codes and models to be used in geomechanical data analysis and repository design.
- o Preparation of specifications for geomechanical testing instruments and equipment.
- o Development of prototype testing equipment.
- o Conducting overcoring tests in the NSTF.
- o Preparation of several chapters of the SCP.

GEOTECHNICAL ISSUES:

- o Magnitude and direction of in situ stress in repository horizon
- o Stability of underground openings
  - o Rock bursts
  - o Ground support
- o Thermal effect on rock strength and isolation
- o High rock temperatures
- o Presence of methane gas + H_2S No

water + pressure ...

TEST FACILITIES:

- o Near Surface Test Facility
  - o Past utilization
    - Block test
    - Full scale heater test
    - Drilling equipment demonstration
    - Training exercises

ROCKWELL ENGINEERING DEVELOPMENT DEPARTMENT (Continued)

- o Future utilization
  - Prototype instrumentation and equipment testing and development
  - Development of test procedures
  - Training and certification of personnel

o Exploratory Shaft Test Facility

- o Geomechanical Tests
  - Small and large flatjack tests
  - Rock support tests
  - Mine-by test
  - Opening deformation monitoring
  - Plate bearing test
  - Direct block shear test
  - Triaxial test
  - Borehole jacking
  - Canister scale heater tests
  - Hydrofracing and overcoring
- o Geophysical Tests
  - Acoustic monitoring
  - Crosshole seismic tests
- o Equipment demonstration
- o Confirmatory testing

REGULATIONS AND THE NUCLEAR WASTE POLICY ACT, NWPA (Continued)

- o NWPA charged the NRC to promulgate by rule the technical requirements and criteria for approving or disapproving licenses and applications.
  - o Result is 10 CFR 60

    a. Establishes that the groundwater travel time from the repository to the accessible environment is greater than 1000 years.

    b. Specifies the containment of the waste within the waste package to be between 300 and 1000 years.

    c. Defines the fraction release rate from the engineered barrier system at less than 1 part in 100,000 per year, ~~or a threshold value~~.

    d. References and employs as needed other NRC Regulations such as:

       1. 10 CFR 20 (important to Safety) ? defined in part 60 part 21
       2. 10 CFR 50 Appendix B (QA)
       3. 10 CFR 50 Appendix F (Fuel Facilities)

    e. Establishes requirements for the SCP (Reg. Guide 4.17)

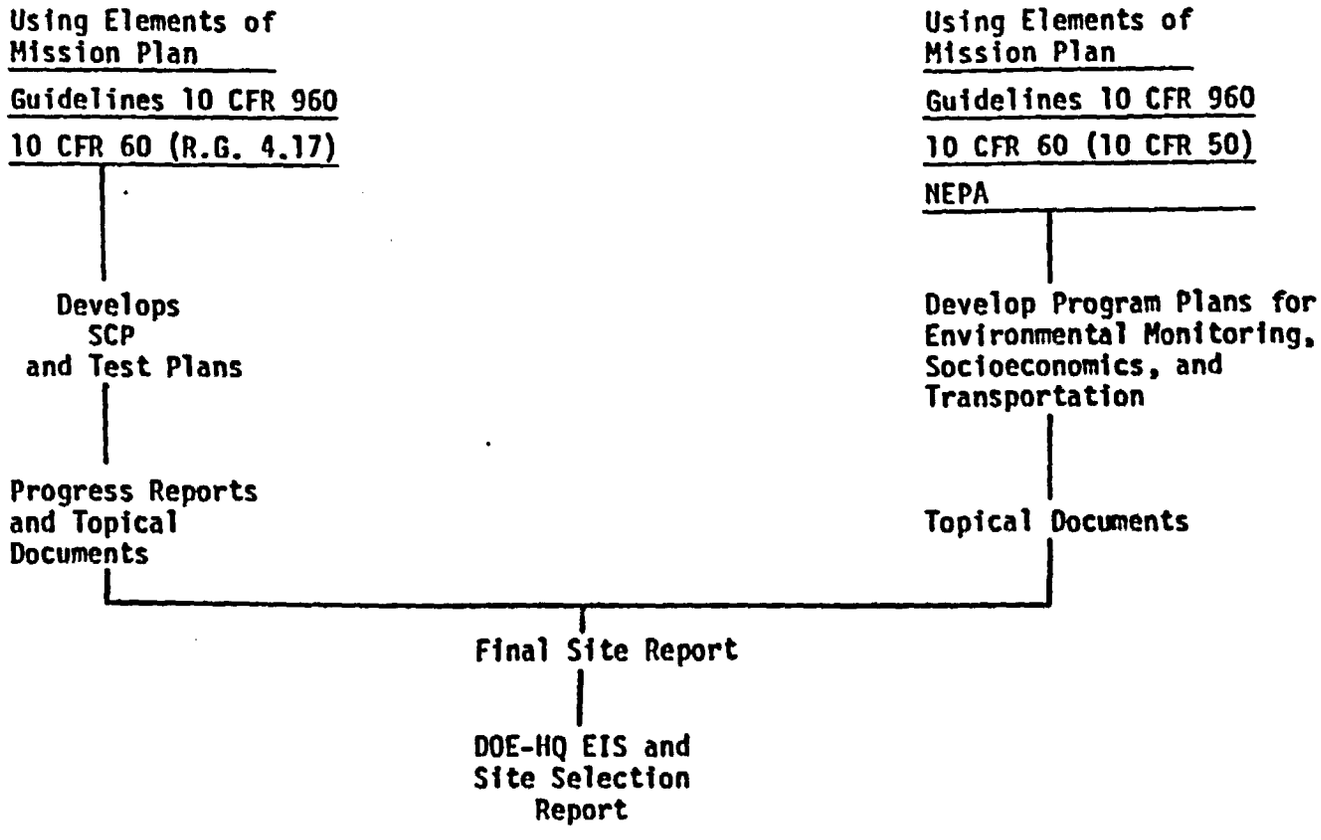
    f. Establishes requirements for the License Application

       1. A Safety Analysis Report
       2. An Environmental Report (10 CFR 51)

Want to include some work done on the E.B.S.

LICENSING REQUIREMENTS FOR SITE SELECTION

- SCR (Historical 1976 to 1982)
- EA (Decision Document Selects Site to be Characterized)



LICENSING REQUIREMENTS FOR SITE SELECTION (continued)

DOE-HQ EIS and
Site Selection
Report

License Application

- o Safety Analysis Report
- o Environmental Report

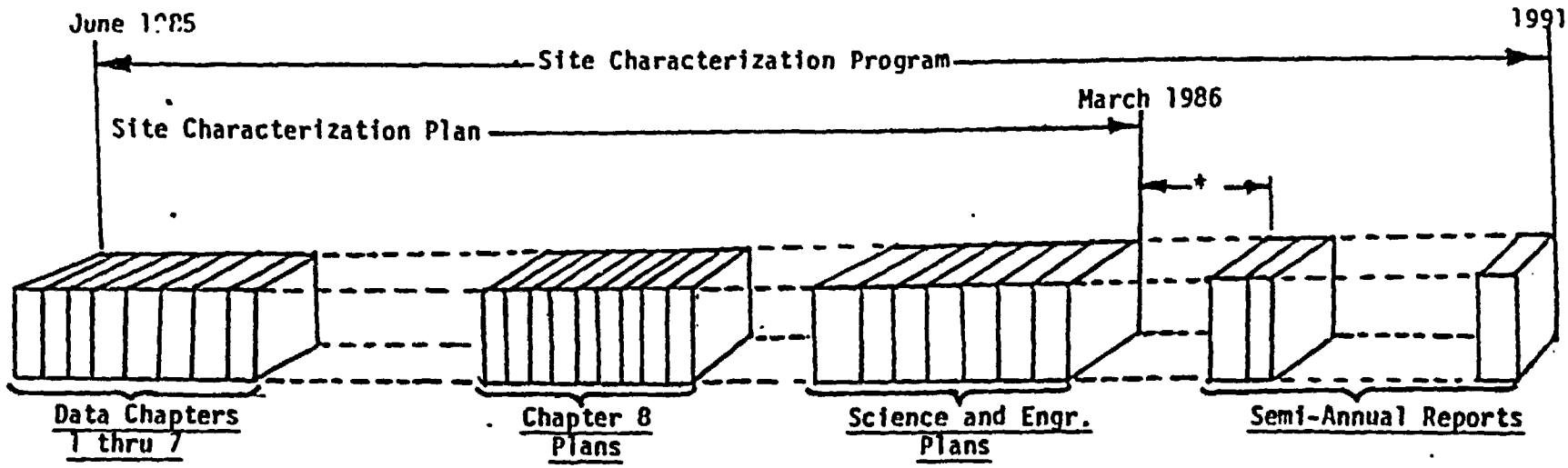
Construction Authorization

License to Receive and Possess
Source, Special Nuclear or
Byproduct Material

RECORDS MANAGEMENT DIRECTIVES

- DOE Order 1324.2 (Records Disposition) ← get this
- DOE-RL Order 1324.1 (Records Disposition)
- SD-BWIP-AP-001 (BWIP Records Management Plan) get this

BWIP SITE CHARACTERIZATION PLAN
CONTENT-SCOPE-SCHEDULES



1. Geology
2. Geoengineering
3. Hydrology
4. Geochemistry
5. Climatology
6. Repository design
7. Waste Package

8.1 Rationale
8.2 Issues
8.3 Planned tests analysis, sched.
8.4 Site preparation
8.5 Milestones
8.6 Quality Assurance
8.7 Decont-Decomm.

Expl. Shaft Test Plan (ESTP)
Repository Conceptual Design

Approx. 10-12 large loose leaf binder volumes
7000 pages
1500 references

*ESTP review and comment period
NRC comments on ESTP must be dispositioned prior to commencing drilling.

KEY HANFORD PUBLIC COMMENT ISSUES TO BE RESOLVED IN FINALIZING EA'S

GEOSCIENCES:

- Concerns about validity of predicted groundwater travel time in EA
- Concerns about earthquakes, stresses, proximity to faults
- Concerns about effects of geochemical environment on radionuclide mobility

ENVIRONMENT:

- Concerns about contamination of the Columbia River - effects on people, ecosystem
- Concerns about combined impacts from commercial and existing defense operations
- Affected Indian Tribes - Religious ties to environment

SOCIOECONOMICS:

- Concerns about effects on employment, housing, etc.
- Concerns about economic impacts
- Concerns about contamination of agricultural commodities

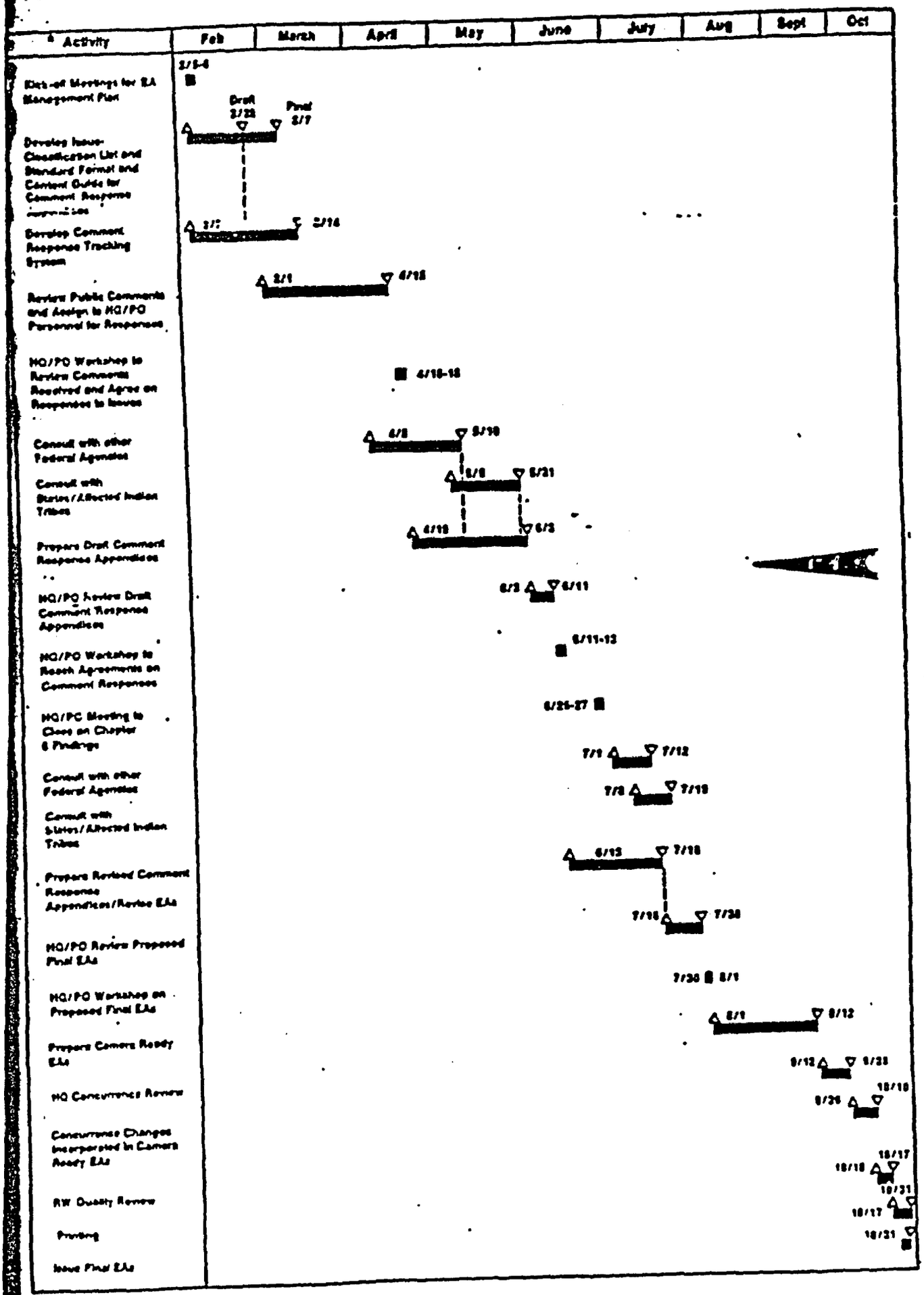
TRANSPORTATION:

- Concerns about transport of high level wastes over public highways and rail systems

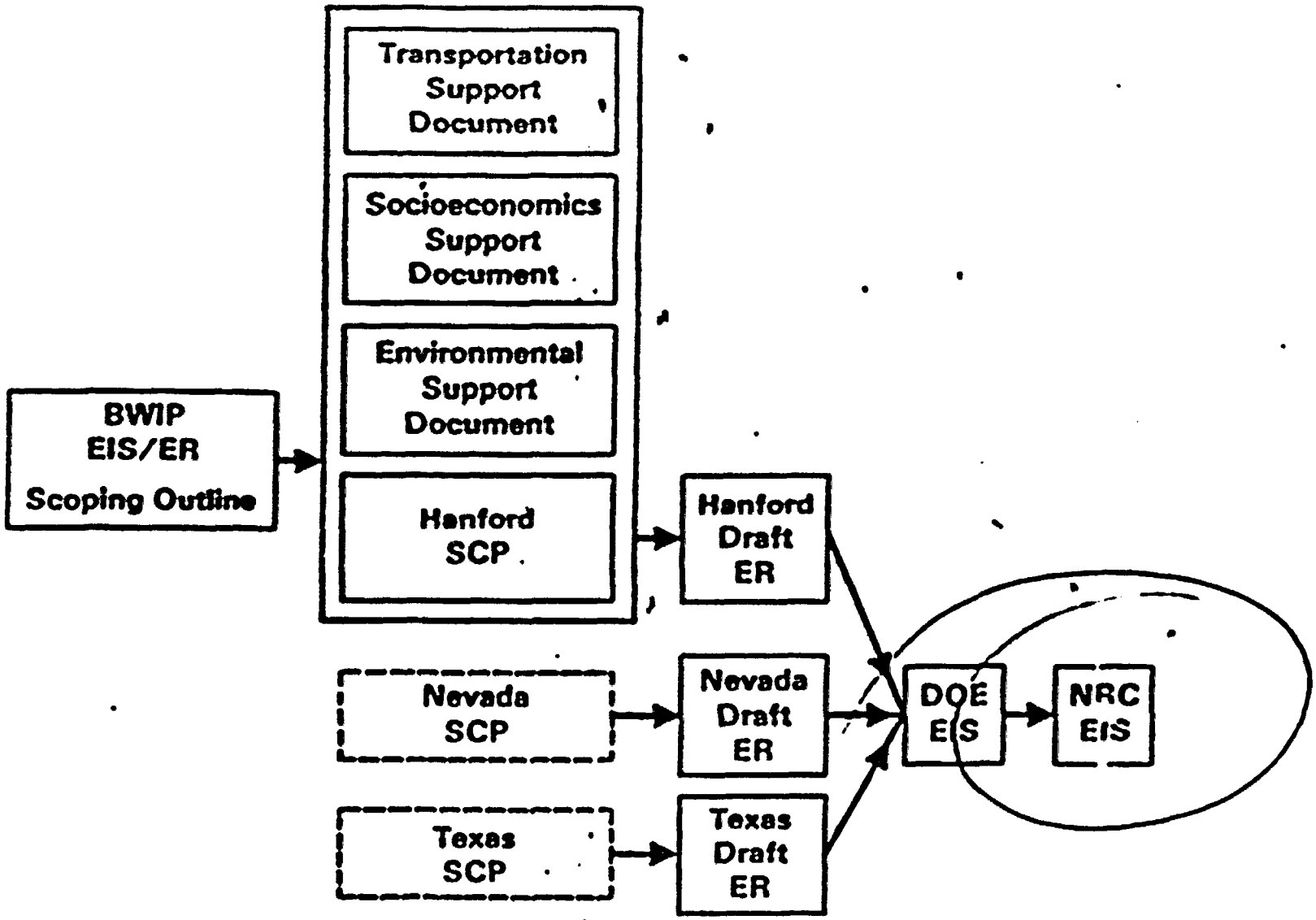
ENVIRONMENTAL ASSESSMENT PROGRAM ACTIVITIES

- Fall 1983 - begin writing BWIP EA
- February 1984 - 1st BWIP rough draft - review by consultants, DOE
- March 1984 - DOE agrees on EA annotated Table of Contents - Management Plan
- June, August 1984 - subsequent BWIP drafts developed, peer reviewed - sent to States and Affected Indian Tribes
- December 1984 - camera-ready copy sent to HQ - nine Draft EA's issued for public comment
- January 1985 - Four Regional Public Information Meetings held to explain EA and comment process
- March 1985 - Five Regional Public Hearings held to receive comments on draft EA's
- April-May 1985 - comment clarification meetings held with NRC, EPA, DOI, States, and Affected Indian Tribes to clarify comments
- Current - 25,000 comments program-wide - 10% BWIP comments

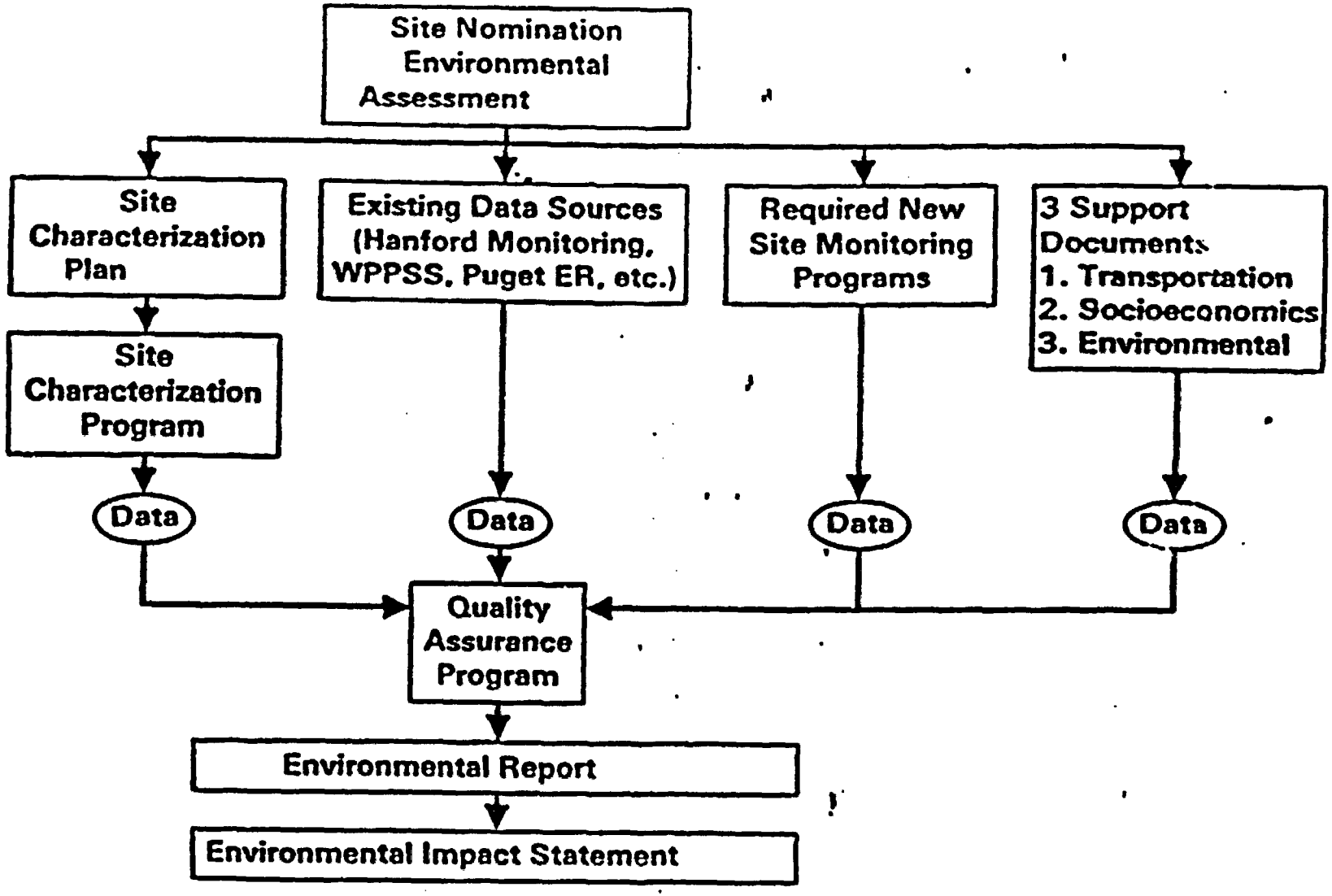
PROCESS AND SCHEDULE FOR PREPARATION OF FINAL EAs



DOE BWIP Licensing Master Plan for Environment, Transportation, and Socioeconomics



Flow Diagram for Environmental Report Preparation



1. NRC

- o Interfaces wi the NRC exist at both the Project and Headquarters levels

DOE-HQ

Governed by the Procedural Agreement known as the Morgan-Davis Agreement

- o Make and negotiate all policy decisions
- o Coordinate and interface all generic technical concerns
- o Overviews, monitors, and provides guidance to the DOE project office
- o Perform arbitration duties as required

DOE-RL

Governed by the Site-Specific Agreement and relevant appendices thereto.

- o Coordinate and deal with the day-to-day technical informational needs, issues, and problems, and interface directly with the NRC On-Site Representative and appointed NRC project manager.

Not paid out of fund.

U.S. GEOLOGICAL SURVEY INTERACTIONS

INTERAGENCY HYDROLOGY WORKING GROUP MEETINGS:

NOVEMBER 17, 1983	REVIEWED HISTORY/STATUS WITH AFFECTED TRIBES AND STATE OF WASHINGTON
FEBRUARY 17, 1984	REVIEWED THE HYDROLOGIC BASELINE MONITORING PLAN
JULY 24-26, 1984	REVIEWED OUTLINE OF PLAN FOR LARGE-SCALE HYDROLOGIC IN SITU TESTING
NOVEMBER 5, 1984	REVIEWED FY 1985 PLANS FOR MODEL DEVELOPMENT
NOVEMBER 27-28, 1984	REVIEWED DETAILED PLANS FOR LARGE-SCALE HYDROLOGIC IN SITU TESTING

USGS/DOE-RL/ROCKWELL

OCTOBER 17 AND 31, 1984	TECTONICS DISCUSSED

Basalt Waste Isolation Project

Presentation for

Representatives from the Office of Inspector General

at Richland, Washington
June 5 & 6, 1985

To: Robert E. Browning MS 62355 Browning

Opinion

Tri-City Herald
KELSO GILLENWATER, Publisher
RICHARD K. PETERSEN, Executive Editor
WILLIAM BEQUETTE, Editor
JACK BRIGGS, Managing Editor
GLENN G. LEE, Publisher Emeritus

Breeding suspicion

One thing the nuclear industry doesn't need is more public suspicion and fear.

Yet the Nuclear Regulatory Commission has launched on a course that will increase public doubts about the safety of nuclear power.

It has used a narrow Supreme Court ruling to justify a wide range of secret meetings that NRC Commissioner Fred Bernthal, the prime mover behind the action, says will improve candor, make this place work better and result in better decisions for the public.

It's a familiar argument, one that is often used by public officials as an excuse for conducting public business in private. But it's fallacious, demonstrating a deplorable lack of understanding of democratic principles.

When the NRC commissioners gave themselves authority to meet out of sight and hearing of the public for general discussions, technical briefings and brainstorming sessions about safety, they dealt a severe blow to the hope that nuclear energy might in time gain public acceptance. There cannot be acceptance until there is confidence that nuclear is safe.

Such confidence cannot be instilled by official public pronouncements.

People must be able to see and hear how the NRC makes safety decisions and how those decisions are enforced, and to weigh the results.

Quote unquote

They have rights who dare defend them. — Roger Baldwin

THE OREGONIAN
Portland, OR
MAY 12 1985

B-3

To understand Hanford story, reporters themselves had to become experts

By LINDA ROACH MONROE

LAST FALL'S IDEA bears fruit in today's editions of The Oregonian, as a series called "The Hanford Gamble" begins.

Editors' note

Whenever a newspaper tackles a long-term project, its staff members struggle with doubts about just how useful such a massive effort is. Does the public really care? How many readers will invest the time to follow a 15-day series on a complicated topic from start to finish? Was the final product worth sacrificing day-to-day coverage to look at "the big picture?"

Beyond those questions, more than six months of pursuing the Hanford story raised other issues of perhaps greater public importance.

The Hanford Nuclear Reservation, founded in the secrecy of the World War II Manhattan Project, has grown into a $973 million-a-year institution while continuing to operate with very little public scrutiny. Yet some of the political dilemmas fundamental to our future — notably, the nuclear arms race and protection of the environment — are played out there every day.

Not a little of the reason for Hanford's low visibility lies in the complex and controversial nature of its work.

When Spencer Heinz, Richard Read and Fern Shen first began collecting information for "The Hanford Gamble," they shared the pervasive Northwest ignorance of the reservation's activities.

"I didn't fully understand whether Hanford was a place or a building or quite what it was," Read said. "I don't think many people know what Hanford is."

"What kind of choice is society making, when the taxpayers don't even realize what they're funding?" Shen added.

The reporters could confidently write their stories only after:

- Wading through books and reports that, stacked together, would stand 20 feet high.
- Touring the reservation numerous times.
- Compiling a phone number list of nearly 400 names.
- Conducting hundreds of hours of interviews.

"We could have written the same number of stories after two weeks of work — and it probably would have been all wrong," Read said.

A simple concept like the difference between radioactivity (a process) and radiation (a result) tripped up the reporters in stories they wrote for daily publication in the early stages of their research — as it continues to confuse many reporters and readers everywhere.

It is this very complexity that forces us, as a society, to rely on specialists to tell us what is best for us. Yet the polarization of nuclear politics makes reporting on Hanford especially difficult.

Linda Monroe edits The Oregonian's Science section.

"It's such a technical subject. I feel like I can go on forever, asking still another expert," Heinz said.

"The people are sincere for the most part, but everybody has an agenda, and at times loses perspective," Read said.

This highly charged atmosphere gave Heinz, Read and Shen their biggest challenge: balancing the biases of all sides to write fair stories.

Indeed, Hanford's officials were concerned enough about the balance of the stories that they sent a delegation in February to talk to top editors of The Oregonian about problems they perceived with "tone" and content of stories that had already been published.

The delegation included Michael J. Lawrence, manager of the reservation for the U.S. Department of Energy; Judy L. Tokarz, acting director of its Office of External Affairs; and Paul Lorenzini, general manager of Rockwell Hanford Operations, a key contractor.

Lawrence emphasized at the meeting that he wanted to be as open about reservation matters as possible — and his employees and contractors often were. In one instance, several Energy and Rockwell officials gave Read a two-day briefing on Hanford waste operations. On another day, more than 20 Rockwell scientists spent at least six hours on the phone answering questions about criticisms of the draft environmental assessment of the Hanford spent-fuel repository proposal.

"The thing that impressed me was, if you had a question, they could almost magically make an expert appear," Read said.

Despite the deluge of experts and information, however, the open door can shut quickly. The Oregonian, the largest newspaper in the Pacific Northwest, still is not routinely notified of breaking news events at Hanford — even when reporters are in contact with Hanford officials on the day the story develops. The most recent instance occurred last Wednesday, when it was revealed that radioactive contamination had been found in ground water near the N Reactor, on the reservation.

The process of putting together "The Hanford Gamble" was not without its lighter moments.

Read took to wearing a bright yellow T-shirt bearing the international radiation symbol. Shen followed a garbage truck to the St. Johns Landfill one afternoon after some of her notes were accidentally thrown away. Heinz thought he had taken one too many trips to the Tri-Cities when he detected an atomic symbol in the onion rings and olive on his chef's salad. Photographer Claudia J. Howell, who shot 150 rolls of film for the project, planned her Mexican vacation around getting one key picture for the series — but the photo subjects didn't appear.

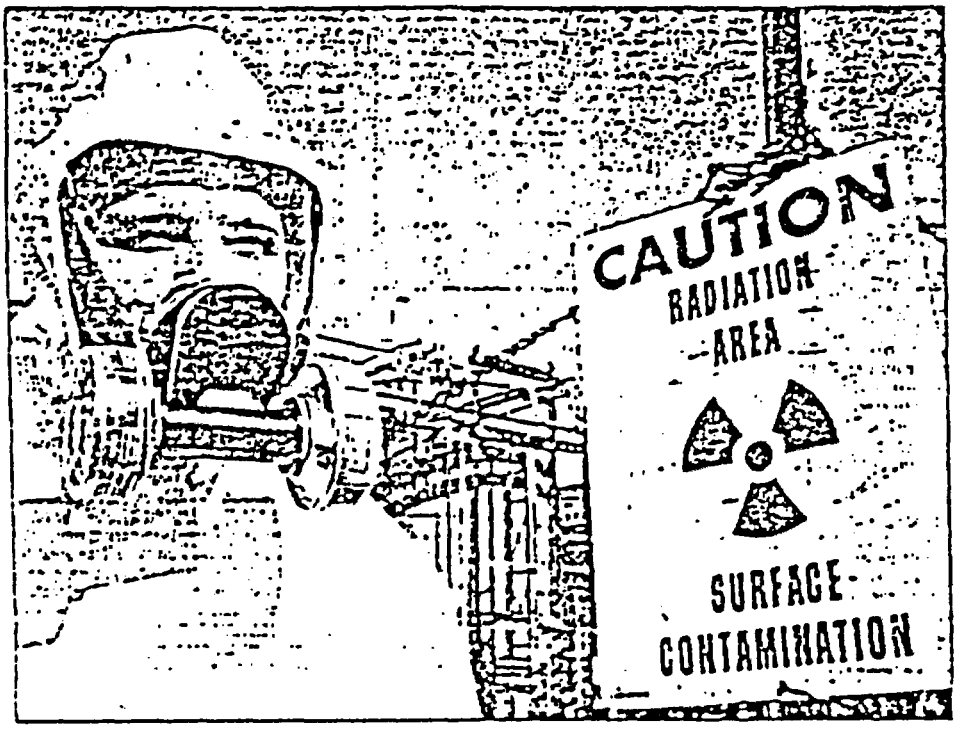
The series represents a substantial investment of time and effort not only for the newspaper, but also for our readers. For 15 days we will be asking readers to take time to understand topics that, at first glance, can inspire more yawns than second looks.

But a second look, which is what we spent more than six months taking, reveals the information needed to assess the impact of a nuclear-fuel repository on the Pacific Northwest's future. And that is what newspapering is all about.

THE OREGONIAN
Portland, OR
MAY 12 1985

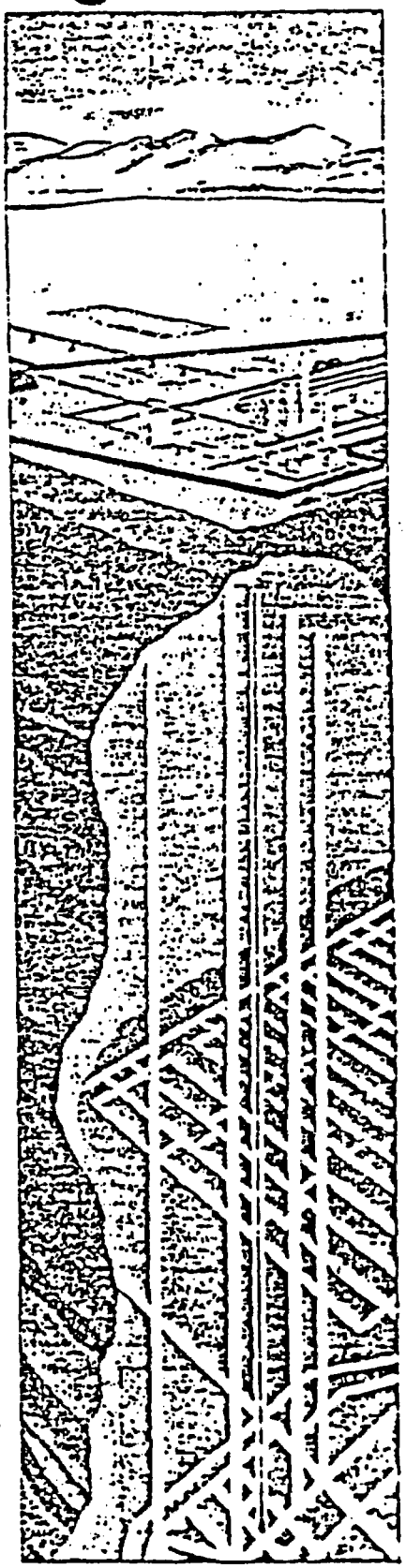
A-1
Pg 1 of 8

Nuclear waste: The Hanford gamble



The Oregonian/CLAUDIA ANDOVELL

SUITED UP — Protective suit shields Laura Vorsicher from radiation near tanks of radioactive waste at Hanford Nuclear Reservation. Hanford could become site of 3,200-foot-deep tomb, right, for spent nuclear fuel.



Doubts remain as stakes grow

Fundamental doubts about safety persist as the federal government pushes the concept of burying the nation's most dangerous radioactive waste four miles from the Columbia River, on the Hanford Nuclear Reservation.

A six-month investigation by The Oregonian shows that the site selection process is a game often without clear rules, played by people with money to make and driven by political tradeoffs that will be forgotten before any mistakes become evident.

A 15-day series of articles beginning today will show that experts close to the process believe politics has infected the scientific effort. They say:

- The national ranking scheme that recently listed Hanford among the top three candidate sites for burying 77,000 tons of nuclear reactor waste degenerated into "a vote-counting numbers game" open to manipulation.
- Despite $353.7 million worth of research so far at Hanford, serious questions remain about its suitability.
- The repository will leak — given enough time — because it is designed merely to prevent waste from reaching living things while still significantly radioactive.

The Southeastern Washington reservation, upstream of 2 million people, is one of three sites that are prime candidates to receive the spent fuel from the nation's nuclear power plants. The others are in Nevada and Texas.

Because humans do not know how to build a structure that would forever contain radioactive substances in the waste, designers propose to slow its escape with "barriers" that include steel canisters and layers of rock. Federal environmental authorities have set a tentative speed limit: Contaminated ground water must not travel farther than six miles in 10,000 years.

Articles in the 15-day series beginning today were researched and written by Spencer Heinz, Richard Read and Fern Shen.

Hanford scientists predict the journey would take 81,000 years through fractured basalt rock. The U.S. Nuclear Regulatory Commission, on the other hand, uses the same data to say the trip could be as short as 1,300 years.

The repository, a maze of tunnels at a depth of 3,200 feet, would be four miles from the Columbia River. The nuclear-age graveyard would cause an estimated 22 deaths and 1,016 disabling injuries to construct. The real issue is the 173,229 truckloads of spent fuel it would entomb.

After spending three years in a nuclear reactor, the used fuel produces lethal levels of radiation and heat at hundreds of degrees Fahrenheit. Some of its components will stay dangerously radioactive for thousands of years. The nuclear industry is anxious to bury it. Because 13,600 tons of the waste already crowd temporary holding ponds in America's 68 nuclear power plants.

The state of Oregon, which has had little to say thus far, does not have the veto power Washington can exercise over the tomb. But Oregon residents would see as many as 5,845 truckloads of spent fuel move through their state annually during 28 years of repository operation beginning in 1998.

The situation is ripe for manipulation because of great public confusion about the effects of radiation on human health. At the heart of the problem is a lack of trust in the U.S. Department of Energy. Accustomed to operating under a cloak of secrecy for its nuclear weapons work, that same agency is leading the civilian search for a nuclear grave.

All nine of the candidate sites picked by the agency have acknowledged drawbacks. Conceding that Hanford in particular may have shortcomings, Chris H. George, the Energy Department official who directed the selection process in the 1970s, said that was acceptable because the sites were diverse.

"There's an analogy here to intelligent gambling" in a "big payoff long shot," George said.

"But that's not necessarily bad," he said. "It's like playing the stock market — if you have a certain amount of diversification, investment in a long shot is not a bad idea."

U.S. nuclear waste problems, Pages C4 and C5.

TOR
MAY 12 1985
Pg 2 of 8

Waste piles up as storage problem festers

First in a series
By RICHARD READ
of The Oregonian staff

RICHLAND, Wash. — When the Hanford Works' first nuclear reactor came to life along a remote reaches of the Columbia River here 41 years ago, its designers and workers did not know what they were making.

Of course some of them knew the B Reactor would become one of three reactors secretly producing plutonium for the war effort. They might have imagined the possibility that the bombs could be used to devastate a city someday — as in fact it was in Nagasaki, Japan, shortly afterward.

Not in their darkest of visions could the atomic pioneers have dreamed that waste produced by the plants — the most poisonous brew ever brewed by humans — would be with us today in tenuous, temporary storage.

But it is.

In fact, despite repeated attempts and predictions to the contrary, neither the government nor the nuclear industry has disposed permanently of a single cubic foot of the nation's most dangerous atomic waste. In total, there are more than 11 million cubic feet of highly radioactive waste in tanks around the country.

The Hanford Nuclear Reservation, which is 150 air miles from Portland on the Columbia River, has grown quietly into the largest atomic dump in the free world. Waste management accidents have occurred there over the years, including one in 1973 in which 115,000 gallons of lethal, acid-laced liquid escaped from a tank that was supposed to have held it to this day. Hanford tanks now hold more than 15 million gallons of such waste.

Around the nation, commercial nuclear power plants have become constricted with piping-hot spent fuel. The current proposal to bury 77,000 tons of spent fuel in a gigantic cavern at Hanford or at one of two other prime sites in the United States is the latest effort to confront the situation.

But, if a nuclear tomb in the Washington desert successfully performed the most complex waste-handling task yet attempted, the success would stand out as an exception to the rule of America's inability thus far to solve its problems with nuclear waste.

The spent fuel and other highly radioactive material, much of which will remain radioactive for a period longer than humans have inhabited Earth, present only two faces of the nuclear junk that has accumulated in the last four decades. Uranium tailings, low-level radioactive waste, airborne waste, long-lived "transuranic" refuse and abandoned nuclear power plants create more atomic headaches.

Shunned for years by the best minds in the atomic sciences and dismissed for decades by the boosters of nuclear technology, the nation's radioactive waste problems have returned to haunt its people.

As technicians strive to assert control over the nuclear legacy, the most potent forms of waste beget additional waste, which in turn spews more.

The characteristics and burgeoning quantities of the nation's radioactive wastes, as well as associated toxic waste and nuclear garbage in other countries, are detailed on Page C5.

Each member of this family of nuclear junk has special characteristics that present unique challenges to caretakers, and amounts of each type have rivaled Houdini in sheer ability to defy elaborate attempts at containment.

Legal challenges over the years have forced the government to prepare waste inventories. The entire amount in the country today represents more than 14 billion curies of radioactivity, according to the U.S. Department of Energy's statistical waste table, the annually updated "Spent Fuel and Radioactive Waste Inventories, Projections and Characteristics."

Everyone agrees that the most radioactive forms of the wastes are dangerous. But whether the danger is immediate, or merely theoretical, remains a matter of debate.

The issue is divided between those who are optimistic and those who are pessimistic, those on the inside and those on the outside. Many of the insiders charged with the job of safely managing the nuclear legacy live in a bureaucracy that is overwhelmingly confident about its ability to use recently developed technology to control nuclear junk.

"We're going to get out of just managing the waste and do something permanent with it," said Jerry D. White, the Energy Department's waste management division director in Richland. The leap of faith that must be taken to exist on the inside is that nuclear technology is good for the country and that the government can control fully all of its byproducts.

Critics on the outside, however, are awed — sometimes to emotional extremes — by the danger of the byproducts. They believe much of the technology is too hot to handle with available technology, and they distrust the historically secretive bureaucracy.

While the insiders develop their normal outlook and even a refined humor, the outsiders develop their own standards and suspicions, which lead them in some cases to the conclusion that the entire nuclear complex should be shut down solely on account of the waste issue.

"When your bathtub is overflowing, the very first thing you do when you find the water flowing down the hallway is to turn off the faucet," said Norman Solomon, a one-time Portland writer who now is disarmament director for the National Fellowship of Reconciliation in New York, a peace and social justice group.

Is the bathtub overflowing? No, says Don Winston, media relations director for the Atomic Industrial Forum, an international nuclear industry group.

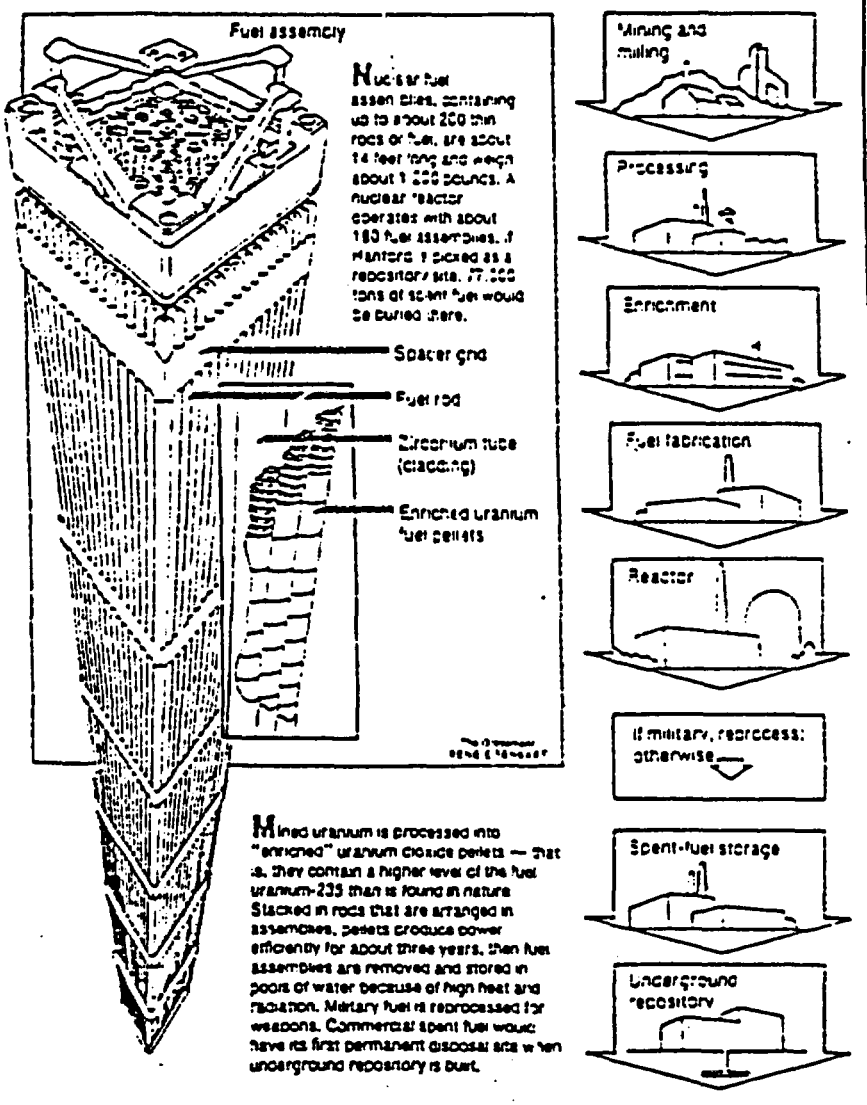
"I think what characterizes the waste situation is the exquisitely small quantities we're talking about," Winston said, adding that spent nuclear fuel is accounted for and may be readily placed in a repository. "There's no question in anybody's mind that you can do it."

But two experiences occurring at either end of a string of incidents show that the United States has failed thus far to isolate radioactive materials from its citizens and the environment.

- From 1946 to 1969, barges and planes dropped radioactive trash into more than 20 ocean dumps in prime fishing areas off the West and East coasts. Radioactive substances are known to be leaking from some of the 47,500 barrels of waste off San Francisco, and scientists disagree on whether the materials are being consumed by fish and concentrated up the food chain.
- Last year, steel reinforcing rods and table bases made in Mexico from radioactive scrap metal accidentally were shipped to 10 states. Investigators were tipped off when a truck took a fortuitous wrong turn and tripped a radiation detector outside the Los Alamos National Laboratory in New Mexico. The metal came from an American radiation therapy machine containing cobalt-60 that originally was shipped for disposal in Juarez, Mexico, where residents unknowingly suffered radiation exposure.

NEXT: The Hanford dump.

The nuclear fuel cycle



THE OREGONIAN
Portland, OR
MAY 12 1985
Pg 3 of 8

Making "The Hanford gamble" a reality involved efforts by several staff members of The Oregonian. In addition to reporters Spencer Heinz, Richard Read and Fern Shen, the team included:

Claudia J. Howell, photographer; Tim Jewett, assistant graphics editor; Rene Eisenbart, artist; John Hamlin, graphics editor; Therese Bottomly, copy editor; John Harvey, news editor; and Linda Roach Monroe, science editor and the primary editor on the project.

What's to come

Monday: The existing Hanford radioactive waste dump.

Tuesday: Life in the nation's nuclear backyard.

Wednesday: How the repository would work.

Thursday: How suitable is Hanford for a repository?

Friday: Transporting the fuel rods across country.

Saturday: The river.

Sunday, May 19: Radioactivity, radiation and how Hanford affects the Northwest.

Monday, May 20: Radiation's effects on workers.

Tuesday, May 21: Waste politics and how Hanford fits in.

Wednesday, May 22: Washington and Oregon responses.

Thursday, May 23: Nuclear boosters and opponents.

Friday, May 24: Who profits, who pays.

Saturday, May 25: National defense and spent-fuel politics.

Sunday, May 26: Science tries to dispose of N-waste.

Curie — A measure of radioactivity, equal to 37 billion atoms undergoing decay in a second. Low levels are measured in picocuries. A picocurie is a trillionth of a curie.

Fission — The process in which atomic particles called neutrons are aimed at atoms of uranium-235. The neutrons cause the atoms to split, releasing heat and radiation. The splitting frees more neutrons, which cause other atoms to split in a "chain reaction." This is the process that occurs inside a nuclear reactor; the fission's heat is used to make steam, which in turn turns turbines that produce electricity.

Fuel rod — A narrow metal tube filled with fingertip-sized pellets of uranium dioxide, the fuel of the nuclear reactor. About a dozen feet long, rods are sealed into fuel assemblies of about 200 rods each. A reactor contains about 100 tons of fuel rods.

Half-life — The length of time for half the atoms in a radioactive substance to decay.

Isotope — Different atomic versions of the same element are called isotopes. The difference is in the total number of particles (called protons and neutrons) in the nucleus. The total is expressed as a number in the isotope's name, as in uranium-235, the isotope that fuels nuclear reactors.

Radiation — Particles or energy thrown off by unstable atoms, also known as ionizing radiation.

Radioactivity — The process by which atoms of some substances "decay," throwing off radiation particles or rays as they do so.

Radionuclide — A radioactive atom.

Chemical waste also produced

Hazardous chemical wastes are produced right alongside radioactive wastes — a fact that largely has escaped notice of the American public.

"There's a tremendous mix of chemicals varying very much from site to site," said Carl G. Welty, a toxicologist in the U.S. Department of Energy's operational safety office environmental protection division.

"We have mainly acids and caustics, some solvents, trichloroethylene, PCBs (polychlorinated biphenyls), pentachlorophenol, sulfuric acid, chlorine, fluorine, mercury, chromates. You name a problem, and we probably have it."

Some of the chemicals come from procedures that would be expected in any major industrial operation. Waste herbicides and pesticides remain from the usual extermination efforts; polychlorinated biphenyls are left from conventional transformers; solvents and oils remain from cleaning and lubrication.

Nuclear power plants produce hardly any hazardous non-radioactive waste in the course of their central mission, but chlorine is used to purify water and chromates are used to fight corrosion and fouling of cooling systems, Welty said.

It is the reprocessing of spent fuel that generates the most toxic chemicals, however, as powerful compounds must be used to dissolve the radioactive pellets inside fuel rods so that useful substances may be extracted.

Chemical baths used to purify uranium leave behind magnesium and various acidic wastes, and other separation procedures leave mercury, Welty said.

Each year, the Energy Department generates enough hazardous chemical waste, about 34,000 tons, to fill a 650-car freight train to weight capacity, not counting the mass of special packaging that would be required to safely transport the material anywhere. Because the government only recently has attempted to estimate total quantities, there is no full accounting of hazardous waste already disposed or stored.

"Those are very rough numbers," Welty said. "We're not nearly as sophisticated in this area as we are in keeping track of radionuclides. There's just too much to keep track of."

A federal court decision last year forced the Energy Department to submit to U.S. Environmental Protection Agency regulation of non-nuclear waste. That suit was brought after the discovery that a bomb parts plant at the Energy Department's Oak Ridge National Laboratory in Tennessee lost 2.4 million pounds of mercury between 1950 and 1977.

The Energy Department is haggling with the EPA to determine how much of the 1.2 million tons of "mixed" wastes produced annually by the government should be classified as radioactive and which as hazardous.

Once existing categories are described and tabulated, officials will be better able to project future quantities. Until then, some of the waste goes to commercial disposal companies for incineration or dumping, some of it leaches through lagoons and trenches, and some remains in temporary storage.

TOR
MAY 12 1985
pg 4 of 8

Numerous agencies watch over nuclear waste

Responsibility for radioactive waste handling and disposal in the United States is split among numerous government agencies.

The U.S. Department of Energy manages waste generated by its own plants, which include defense plants that extract plutonium for weapons and produce liquid high-level waste. The Energy Department manages research on methods of handling and disposing radioactive waste.

It is the Energy Department that must design, build and operate the nation's repositories for spent fuel.

The U.S. Nuclear Regulatory Commission licenses temporary storage of radioactive waste and must license the repositories. The commission regulates spent fuel stored at power plants.

The U.S. Environmental Protection Agency is responsible for developing environmental and health standards for radiation leaving plants, including the repositories. The EPA also monitors the Nevada Test Site for any inadvertent release of radioactive debris from test nuclear explosions set off deep underground.

The U.S. Department of Transportation regulates both the packaging and transportation of nuclear waste, setting limits for external radiation levels and contamination.

The U.S. Geological Survey conducts scientific research and evaluation of waste disposal plans. The U.S. Bureau of Land Management manages public lands that the U.S. Department of the Interior may withdraw for the use of the Energy Department for waste disposal.

The U.S. General Accounting Office issues occasional reports on efforts of other agencies to control waste. International bodies — such as the International Atomic Energy Agency with headquarters in Vienna, Austria — coordinate research and distribute safety guidelines.

Congress, which sets this country's waste agenda, has held various committee hearings on the subject. The president, who must decide on the site of the first repository subject to veto by affected states and tribal organizations, is pondering whether to mix defense and commercial waste in the repository.

The courts have been involved in waste management issues before and are expected to become increasingly involved in disposal questions as federal agencies move toward building the first repository. A number of suits are pending in the 9th U.S. Circuit Court of Appeals in San Francisco. The 9th Circuit includes Washington and Oregon, among other states.

Local jurisdictions, where activists have pushed for "nuclear free" zones, also are beginning to assert authority.

THE OREGONIAN
Portland, OR
MAY 12 1985

Pg 5 of 8

Atomic activities take toll worldwide

By RICHARD READ
of The Oregonian staff

Major radioactive contamination in a region of the Soviet Union's southeastern Ural Mountains in the 1950s led to mass evacuations and razed villages, Soviet and American scientists have reported.

The incident was one of several showing that atomic waste has taken a toll abroad. The most serious incidents appear to have occurred in connection with nuclear reprocessors, plants that extract plutonium or uranium from spent fuel.

Eleven nations — from Argentina to Pakistan — are committed to commercial reprocessing of spent fuel of civilian nuclear power plants. The practice, conducted in the United States only with defense fuel, allows a "closed" fuel cycle in which spent reactor fuel is recycled, either to fuel breeder reactors or to power nuclear bombs.

Reprocessing is controversial not only because of the nuclear-weapons fuel it produces, but also because of the liquid waste it leaves behind.

Worldwide reprocessing produced 551 tons of high-level radioactive waste last year, an internal Battelle Pacific Northwest Laboratory report estimates.

It was the liquid waste, one way or another, that apparently led to the contamination in the Urals. Soviet geneticist Zhores Medvedev first claimed in a book that the area was poisoned by an explosion in a radioactive waste dump.

But in 1982, two Los Alamos (N.M.) National Laboratory scientists concluded from classified U.S. government reports that radioactive leftovers from a reprocessor's contaminated holding pond were dispersed widely either by high winds or a chemical explosion. The sudden contamination added to radioactive pollution in rivers and lakes from cooling water that had been discharged by military reactors, wrote chemist Diane M. Soran and physicist Danny B. Stillman.

In the 1960s, "death squads" of prisoners were sent into the area near the city of Kyshtym to dump truckloads of sand on a heavily contaminated dry lake bed, Soran and Stillman wrote. When the dump trucks became too contaminated, they apparently were abandoned and covered with soil by the prisoners, many of whom died from radiation sickness, the Los Alamos scientists wrote.

A French reprocessing plant has experienced repeated accidents, and another on England's northwest coast is the self-proclaimed dirtiest nuclear plant in the world. Con Allday, the chairman of British Nuclear Fuels PLC, which operates the Windscale Works, has said Windscale discharges more radioactivity into the environment than any other in the world.

In more than 30 years, the British plant has dumped half a ton of plutonium mixed with waste water through a 1.5-mile pipeline, which has sent traces of contaminants through the ocean reportedly as far as Norway and Greenland.

Material accidentally flushed through the pipeline last year washed up on local beaches, and even before then government tests on mollusks and codfish had shown radioactivity levels many times normal.

The ocean has served as a major dumping ground for solid wastes from other countries as well. But in an international convention on dumping held in London last year, several nations pledged to halt their practice of pitching low-level radioactive waste into the Northeast Atlantic Ocean.

Research on the consequences of that dumping will be presented at a follow-up convention in September, when a decision is expected on whether to resume the practice. At present, no countries dump solid radioactive refuse into the oceans to the knowledge of Kent M. Harmon, a Battelle expert on international waste.

Almost every country produces some radioactive waste, if only from medical sources and research. Twenty-six countries have a total of 318 nuclear power plants operating, and eight more countries plan to commission plants by the end of the century, according to the American Nuclear Society, an organization of nuclear engineers.

Each plant will produce waste before turning into waste itself.

Nuclear plants abroad produced four times the amount of spent fuel generated in the United States last year, the draft Battelle report estimates. Most of the foreign countries do not reprocess and instead use the "once-through" fuel cycle in which spent fuel is considered waste.

To prevent international reprocessing that could lead to production of nuclear bombs overseas, the United States requires the return of atomic fuel originally loaned to other countries for civilian power production. Periodic shipments of the spent fuel arrive in Portland destined for the Idaho National Engineering Laboratory, about 40 miles west of Idaho Falls.

International shipments of larger quantities of spent fuel occur frequently as nations such as Japan have their spent fuel reprocessed elsewhere. West Germany is the most recent country to announce plans to reprocess; plans announced this winter to build a $3 billion plant near the Czechoslovakian border are expected to provide a new focal point for activities of West Germany's anti-nuclear movement.

The Soviet Union does not at this time reprocess civilian spent fuel, according to U.S. Department of Energy information.

"We know very little about what they do, except they say they work on just about everything in the nuclear field," said Alex F. Perge, special assistant to the director of the Energy Department's office of civilian radioactive waste management integration division. "Somewhere they have the equivalent of Hanford."

TOR
MAY 1 2 1985
Pg 6 of 8

7 types of N-waste

Mill tailings

A abandoned uranium mill tailings litter the West.

The tailings are earthen residues left from the process that extracts uranium oxide for later refining into reactor fuel. The sign at right keeps the public out of tailings-contaminated land at an abandoned mill near Lakeview, in south-central Oregon.

Only a fraction of 1 percent of the ore's volume is extracted in the milling process. The finely ground remainder is put in settling ponds, where it dries eventually into sandy particles, which are placed in dames or piles.

The waste contains radioactive elements including thorium-230, which takes 80,000 years to lose half its low level of radioactivity.

The tailings also continuously produce radon gas, which decays into radioactive substances that cling to dust particles or cigarette smoke. When inhaled, the particles can become lodged in the lungs and contribute to formation of lung cancers.

Quantities of tailings at currently operating mills in the United States would fill more than 140 Portland Civic Stadiums to the roof level. Amounts at defunct sites would fill 21 more stadiums. The total amount of uranium mill tailings is expected to nearly double by the year 2000, with most of the wastes in Colorado, Wyoming and New Mexico.

Contaminated soil, rubble, riprap, stabilizing material, bikes, road material and windblown contaminated surroundings near the defunct sites would fill another 12 Civic Stadiums. Some material from the piles has leached into water systems.

In Oregon, a study ordered by Lake County commissioners found no evidence linking the uranium tailings to a slow rise in the incidence of lung cancer there, said Dr. William E. Morton, Oregon Health Sciences University environmental medicine professor.

Between 1952 and 1966, the Climax Uranium Co. of Grand Junction, Colo., released hundreds of thousands of tons of tailings for use in construction projects. Health officials discovered that occupants of 526 resulting structures were inhaling more gas that seeped up through floorboards of radioactive foundations.

Certain Navajo Indian populations near abandoned mines and tailings in the Southwest have experienced cancer, miscarriages and two to eight times more birth defects than normal, March of Dimes research has found. Further studies have found respiratory disease and lung cancer associated with presence of uranium mines and tailings, said Lynda Taylor, radiation and health project director for the Southwest Research and Information Center, an Albuquerque, N.M., environment and health research and advocacy organization.

Spent fuel

Growing spent fuel crowds the temporary storage pools of nuclear power plants as the United States debates what to do with its most dangerous atomic waste.

"A typical 1,000-megawatt plant discharges annually about 25 tons of spent fuel," said Robert W. Bowen, a consulting engineer in the U.S. Department of Energy office of storage and transportation systems. That meant 1,600 tons of the "burned" fuel had accumulated in temporary storage by 1984.

Spent fuel is created at the very heart of a nuclear reactor. Uranium-235 atoms within nuclear fuel pellets are split during the chain reaction that occurs inside the reactor core. Heat from the process is used to produce electricity, but the fraction shows as uranium-235 supplies diminish and byproducts accumulate.

As a result, a third of the fuel rods in a nuclear power plant must be replaced each year. At right are fuel pellets that have not yet become highly radioactive in a reactor core.

Each of the country's 48 operating commercial nuclear plants has a similar spent pool holding fuel rods, which are to be put eventually into an underground repository, perhaps at Hanford Nuclear Reservation in Southeastern Washington.

The nation's current tonnage is minuscule compared to the amount of waste produced annually by just one coal-fired power plant. One of those plants often produces more than 1,200 tons of ash a day.

Still, if the nation's current amount of spent fuel could fill full-size trucks to their weight capacity, the resulting bumper-to-bumper convoy would stretch from Portland to Salem. But heat and radiation from unshielded spent fuel would quickly kill anyone who approached the trucks to drive them. It is those properties that give the nation's spent-fuel problem its urgency.

The used fuel is only one-tenth of 1 percent of the volume of all the country's radioactive waste, but it accounts for about 80 percent of the waste radioactivity, according to the most recent federal figures.

Most of the waste's components will lose their significant radioactivity within a century, but some will emit radiation for millions or billions of years.

Water in the storage pools cools the fuel pellets, which are packed into narrow 14-foot zirconium rods that are in turn held in 200-rod fuel assemblies. If left in the water, the rubes around the pellets would eventually corrode and crack open, releasing radioactive gas.

The old Atomic Energy Commission had hoped to place the spent fuel in an abandoned salt mine in Lyons, Kan., but that idea was stopped after 1972 when severe hydrological problems were found with the site. The process under which Hanford is being considered for an underground repository is the latest attempt to dispose of the spent fuel.

Meanwhile, the Nuclear Regulatory Commission has issued permits enabling the plants, including the Trojan plant operated by Portland General Electric Co., to rearrange their racks in their storage pools to hold more spent fuel than originally intended.

"If they didn't do anything more along these lines than has already been done, we project that the first reactor would run out of space by 1987," Bowen said. The Energy Department predicts that by the year 2000, in the absence of fuel reprocessing, the nation will have accumulated enough spent fuel to extend the nation's bumper-to-bumper line of pickups from Portland to beyond Roseburg.

High-level

Tracks of high-level waste wait near U.S. nuclear weapons plants as government officials ponder the fate of these "hot potatoes."

The high-level waste is extremely radioactive liquid left after valuable substances — chiefly plutonium for bombs — have been extracted from spent fuel.

Reprocessing plants, such as the PUREX — plutonium-uranium extraction — plant at the Hanford Nuclear Reservation, generate the poisonous stew.

Most of the nation's high-level waste has come from defense reactors producing material for nuclear bombs. Current quantities, 11.3 million cubic feet, would fill about 750 swimming pools the size of the one at Portland's Metro Center YMCA.

High-level waste is probably the most troublesome type of waste because of its heat, its rapid radioactive decay and its ability as a corrosive liquid to leak from containers.

Some high-level waste includes enough cesium and strontium to be "self-boiling," so special procedures are used to remove these particularly hot substances and vacuumate them. The U.S. Energy Department has begun to hand over some of the resulting capsules, like the water-immersed cesium capsules at right, to industry to power remote lights or to preserve food by irradiation.

At Hanford, where two-thirds of the country's high-level waste is stored, waste containing 250,000 curies of radioactivity has leaked from storage tanks over the years.

Most of the rest of this type of waste is stored at the Idaho National Engineering Laboratory near Idaho Falls and the Savannah River Plant near Aiken, S.C.

The volume of high-level radioactive waste is expected to grow by the year 2000, chiefly because of plans to compact it by evaporation and solidification. How much is generated depends on whether companies resume reprocessing of commercial spent fuel, a practice suspended under President Carter because of nuclear proliferation concerns but authorized more recently by President Reagan.

Before the moratorium, the government had tried to deal with the spent-fuel problem by encouraging private industry to enter the reprocessing business. But the process — traditionally touted as the centerpiece of nuclear technology — thereby created more high-level waste.

One of the reprocessing plants failed before opening in Morris, Ill., because a dry run found its technology to be unworkable. The second plant, in Barnwell, S.C., proved uneconomical and was never completed, but the Reagan administration is trying to resurrect it.

The third, in West Valley, N.Y., was unable to meet new environmental standards and closed in 1972, leaving 60,000 cubic feet of high-level waste, much of which originated from Hanford spent fuel.

Transuranic

Transuranic waste, a form of radioactive refuse whose danger was not fully appreciated initially, lies in shallow burial alongside lesser offspring of the nuclear legacy.

The refuse is composed of extremely long-lived radioactive elements such as plutonium and americium that are heavier than uranium. At right, transuranic waste sits in temporary storage on asphalt pads at Hanford.

Transuranic garbage was buried along with low-level waste for years until the government decided in 1970 to segregate it for special handling because of its radioactive longevity. Common substances in the waste are at least six times as radioactive as enriched uranium ready for use in a reactor, and some of them will take millions of years to lose half their radioactivity.

The trash is contaminated material including dirt, gravel, asphalt, filters, cemented sludges and combustible substances in cans. U.S. Energy Department officials are candid about their inability to measure exact quantities of this form of atomic waste — and amounts vary as the definition changes. Last year, the government increased the standard of radioactivity for transuranics by 10 times, a decision that reduced the amount of waste classified that way.

"An accurate assessment of the buried volumes of transuranic waste at DOE sites is difficult," said a waste management report last September, "because early burial techniques were not governed by the current requirements."

That report estimates the Energy Department in 1983 was watching about 3.6 million cubic feet, which is enough to fill more than 2,500 conventional enclosed tractor-trailer trucks.

Officials are unable to estimate the additional quantity buried in commercial dumps.

"Over the years, some of the buried waste containers have been breached and the surrounding soil has been contaminated," report RW-1006 continues.

"It is very difficult to accurately determine the amount of contaminated soil, and the estimates cover a rather broad range.

"Also, in the early days at Hanford . . . some liquid waste that contained transuranic elements was spilled on or drained to the earth."

Jean Pruitt, the Energy Department defense programs public information officer, said transuranic quantities were increasing at a rate of 192,500 cubic feet per year.

At that rate, the inventory of defense-related transuranic waste will increase about 28 percent by the year 2000.

THE OREGONIAN
Portland, OR
MAY 12 1985

Low-level

Some low-level radioactive waste lies below earth fill in government and commercial dumps. Other low-level waste leaches through ground water and flows through the ocean deep.

The waste is generated at all stages of the atomic fuel cycle, from the uranium mine shaft to the nuclear power plant to factories that reprocess spent fuel. It is also a byproduct of certain industrial and medical processes.

Hanford defense plants continue to pour more than 100 million gallons of liquid low-level waste into the desert soil each year, and the federal Oak Ridge National Laboratory mixes hundreds of thousands more gallons with grout and injects it into Tennessee shale. At night are containers of low-level radioactive refuse at Hanford, in one of the United States' three operating commercial low-level dumps.

Low-level garbage is a catchall category covering contaminated rags, paper, air filters, insulation, clothing, bulky reactor parts and cement-encased sludges and more. If all of the country's solid low-level junk could be gathered on a Portland city block, it would tower as high as nearly four 43-story U.S. Bancorp Towers placed one atop the other.

But the government cannot account for large amounts of low-level waste only last year did the U.S. Nuclear Regulatory Commission set up a "cradle-to-grave" manifest tracking the substances.

From 1946 to 1969, the federal government used planes and ships to dump 55-gallon drums of low-level waste into the ocean, a practice common among other countries until an international agreement suspended it last year.

The U.S. Department of Energy estimates that the United States dumped 34,383 drums into the Atlantic Ocean and 55,289 drums into the Pacific through 1969, according to a 1984 Energy Department report, "Spent Fuel and Radioactive Waste Inventories, Projections and Characteristics." Many drums have ruptured.

About two-thirds of the nation's low-level radioactive waste in this country was generated by the federal government.

The other third came from thousands of industrial companies, research laboratories and hospitals. Some commercial waste is buried in special incinerators, but the majority last year ended up buried at the U.S. Ecology Inc. commercial dump at Hanford.

Another U.S. Ecology dump is in Beatty, Nev., where townspeople once unwittingly preferred contaminated items from stocks to panelling to a cement mixer, which was used to build a floor before officials discovered the situation and ordered a massive cleanup. The nation's other operating commercial low-level dump is in Barnwell, S.C., where state officials are anxious to curtail operations.

An atomic graveyard in Sheffield, Ill. — also operated by U.S. Ecology, formerly known as the Nuclear Engineering Co. Inc. — closed in 1978 after reaching capacity at 3 million cubic feet of waste. Tritium — radioactive hydrogen — has entered the ground water there, and officials are concerned about migration of other substances.

Radioactive substances also are leaching out of the country's two other closed dumps for low-level radioactive waste, at West Valley, N.Y., and Maxey Flats, Ky.

Oregon and Washington each produce more than 45,000 cubic feet of low-level garbage annually, making them the 17th and 20th states in generation in 1982. About a quarter of Oregon's waste comes from the Trojan Nuclear Plant, and the remainder comes from about 200 institutions and businesses in the state.

Airborne

Airborne radioactive particles are emitted routinely — and sometimes accidentally — by nuclear power plants, accelerators and plants that process atomic fuel and weapons materials. At night is PUREX, Hanford's plutonium-uranium extraction plant, and its 200-foot-tall stack.

Most airborne radioactivity comes from uranium mining. But nuclear plants discharge substances including tritium, deuterium, argon-41, carbon-14, krypton-85, xenon-133 and iodine-129.

Gases containing particles of uranium and plutonium also are emitted into the atmosphere, where they join natural background radiation and fallout from weapons testing. Some of the emissions are filtered through sand or fiberglass or other materials that themselves become radioactive wastes.

From 1 million to 2 million curies of radioactivity are released to the atmosphere each year by U.S. Department of Energy plants, according to the most recent summary of environmental monitoring reports issued by the agency.

"Total atmospheric releases increased about 20 percent in 1983," said the report, which also noted that potential radiation doses from gaseous and liquid effluents were consistently within Energy Department health limits. "No significant impact on the health and safety of the public or environment was observed."

"Unplanned releases" are listed individually in department reports.

"On March 23, 1983, vegetation samples were collected around the Savannah River Plant after approximately 4,000 curies of primarily tritium oxide were released over a 12-hour period," reports one of those accounts of a South Carolina release.

"The calculated dose from this release to a hypothetical individual at the plant boundary was less than six-tenths of a millirem, which is less than one-tenth of 1 percent of natural background levels."

The Sierra Club waged a tough court battle last year in an attempt to hold the U.S. Environmental Protection Agency to its Clean Air Act responsibilities of issuing regulations on radioactive emissions.

On Dec. 11, a federal judge found William Ruckelshaus, then-administrator of the EPA, in contempt of court for not issuing standards.

Just in time to avoid penalties of the citation, the EPA issued final standards Jan. 6 for elemental-phosphorus plants, certain nuclear research installations and certain government-regulated sites using radioactive materials.

The agency's reluctance to issue the limits followed Energy Department complaints that doing so would open the floodgates to suits, according to correspondence obtained under the Freedom of Information Act by Charles W.F. Bell, a Portland resident in the Hanford Oversight Committee, a coalition of Northwest peace, labor, religious and environmental groups.

The new limits were more than twice as lax as those suggested originally by EPA staff members, who now say the standards are low enough to protect public health and safety. Sierra Club lawyers disagree and describe the standards as "so weak" that they are meaningless.

Old N

Every nuclear plant eventually will become a white elephant.

Equipment inside a commercial reactor becomes worn out from extended bombardment by radiation during a plant's expected operating life of 30 to 40 years.

The Portland General Electric Co.'s Trojan plant, at right, will reach the end of its licensed operation in 2012. If PGE then decides repairs and relicensing are not worth the costs, the plant will shut down and become classified as decommissioning waste.

Such plants must be mothballed, enclosed in concrete or otherwise decommissioned. Proper closure of a typical power plant would yield about 10,000 cubic feet of high-level radioactive waste; 100,000 cubic feet of low-level waste; and more than 1.7 million cubic feet of uncontaminated waste, according to the American Nuclear Society, a group of nuclear engineers.

Severe nuclear accidents can produce decommissioning waste. At minimum, cleanup of the 1979 Three Mile Island nuclear power plant mishap in Pennsylvania will yield 1,200 cubic feet of damaged fuel assemblies and core debris and 100 times that volume of contaminated, packaged trash.

Military decommissioning will produce more waste. In the next two or three decades, the U.S. Navy will take 100 nuclear-powered submarines out of service, yielding spent fuel and other atomic refuse.

The reactor vessel from the USS Sea Wolf, the Navy's second nuclear-powered submarine, was determined to be "insurable" in 1959 after two years. Spent fuel was reprocessed, but the vessel and components — containing 33,000 curies of cobalt-60 — were dropped into the ocean off Delaware. Because of its half-life of five years, the cobalt-60 has decayed by now to about 1,300 curies of radioactivity.

"They were placed on a barge escorted by the U.S. Coast Guard to a disposal site in the Atlantic Ocean 120 miles off the East Coast of the United States and sunk in 3,000 feet of water," said a statement released recently by Lt. Cmdr. David Carlson, a Navy media information officer in Seattle. "The radioactivity should remain in the reactor vessel while it decays away, and no significant effect on the marine environment is expected."

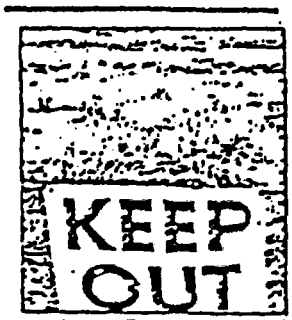
But the Navy was concerned enough about the vessel and barge to use sophisticated equipment subsequently during an all-out effort several years ago to find the submarine. Carlson confirmed. The sub was never found, he said.

The U.S. Department of Energy presides over an oddball collection of contaminated installations known as remedial action wastes. These white elephants include about 200 surplus installations: contaminated rubble, fields and buildings used by the World War II Manhattan Project and old laboratories and other equipment from the days of the Atomic Energy Commission.

The contaminated material has ranged from soil at the St. Louis Airport to floor tile at the University of California at Berkeley to plumbing, soil and building material at Oregon's Albany Metallurgical Center. The center is expected to yield 99,000 cubic feet of plumbing, soil and building material contaminated with long-lived isotopes uranium-238 and thorium-232.

Quantities of both low-level and highly radioactive wastes from decommissioned plants will increase slowly through the rest of the century, the Energy Department predicts. After that, as many plants reach the end of their useful lives, quantities of both types are expected to increase dramatically, reaching more than 130 times today's volume by the year 2020.

THE OREGONIAN
Portland, OR
MAY 12 1985



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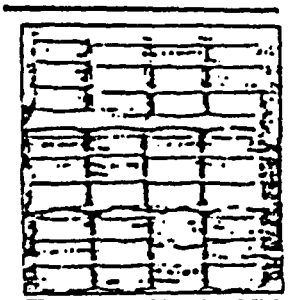
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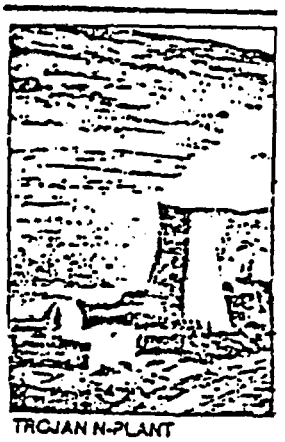
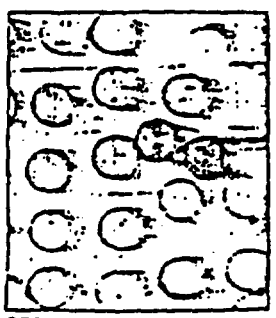

TROJAN N-PLANT

FUEL PELLETS (before use)

WASTE BARRELS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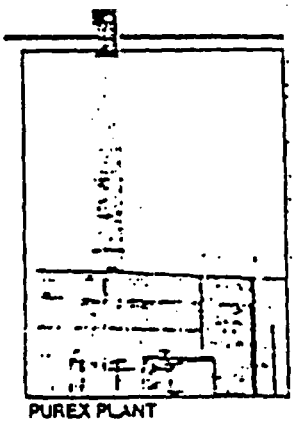

PUREX PLANT

THE OREGONIAN
Portland, OR
MAY 13 1985 A-1 Pg 1 of 8

Hanford nuclear waste site already listed as world's biggest

Second in a series

By RICHARD READ
of The Oregonian staff

RICHLAND, Wash. — The multibillion-dollar proposal to put a nuclear fuel repository at the Hanford Nuclear Reservation writes another chapter in a checkered history that already has made Hanford the largest known nuclear dump in the world.

Unless the Soviet Union offers any bigger, the Southeast Washington reservation boasts the largest collection of nuclear waste anywhere. Hanford already contains 60 percent of

America's high-level radioactive defense waste. It holds half of the country's buried transuranic waste, the heavy substances that bear especially long-lived radioactivity.

Hanford has three-quarters of the government's low-level radioactive waste. And it is host to the country's fastest-growing commercial dump for low-level radioactive trash.

Only the Savannah River Plant near Aiken, S.C., begins to rival Hanford's standing as the quintessential national atomic cemetery — and then only in the one category of total high-level waste radioactivity, according to 1983 government inventories.

If Hanford were chosen to care perpetually for spent fuel from the nation's nuclear plants, it would cement the reservation's status as king of the atomic dumps. It is that possibility — that a deep repository may be carved from Hanford basalt — that calls the reservation's waste management practices into public review.

Hanford has not been able to control fully the waste it already has. The government's last published compilation of waste accidents, prepared in 1975, lists numerous tank leaks and 59 other "unplanned releases."

Problems with Hanford wastes have ranged from the leakage of 491,300 gallons of highly radioactive liquid waste into the soil from corroded tanks since 1959, the most recent incident occurring last August; to the leakage of cesium, strontium and plutonium from a pipe in 1980, contaminating about 200 square feet of soil; to the spilling of dilute sodium nitrite into a waste pond this year from the PUREX (plutonium-uranium extraction) factory, which makes fuel for nuclear bombs.

The reservation's chief proprietor, the U.S. Department of Energy, says that such accidents have become far less frequent. But officials acknowledge that no one knows how much radioactive material has left the 364,300-acre reservation accidentally in four decades of operation.

The department says at least 2,000 acres of Hanford land — an area almost the size of Portland International Airport — already are so contaminated that cleanup would be virtually impossible.

"They've never had a healthy respect for the material they're dealing with," said Eileen Buller of the Hanford Oversight Committee, a coalition of Northwest peace, labor, environmental and religious groups. "I think we're in for some rude awakenings down the line."

Energy Department officials and government contractors said some of the waste would have been managed differently if they had it to do over.

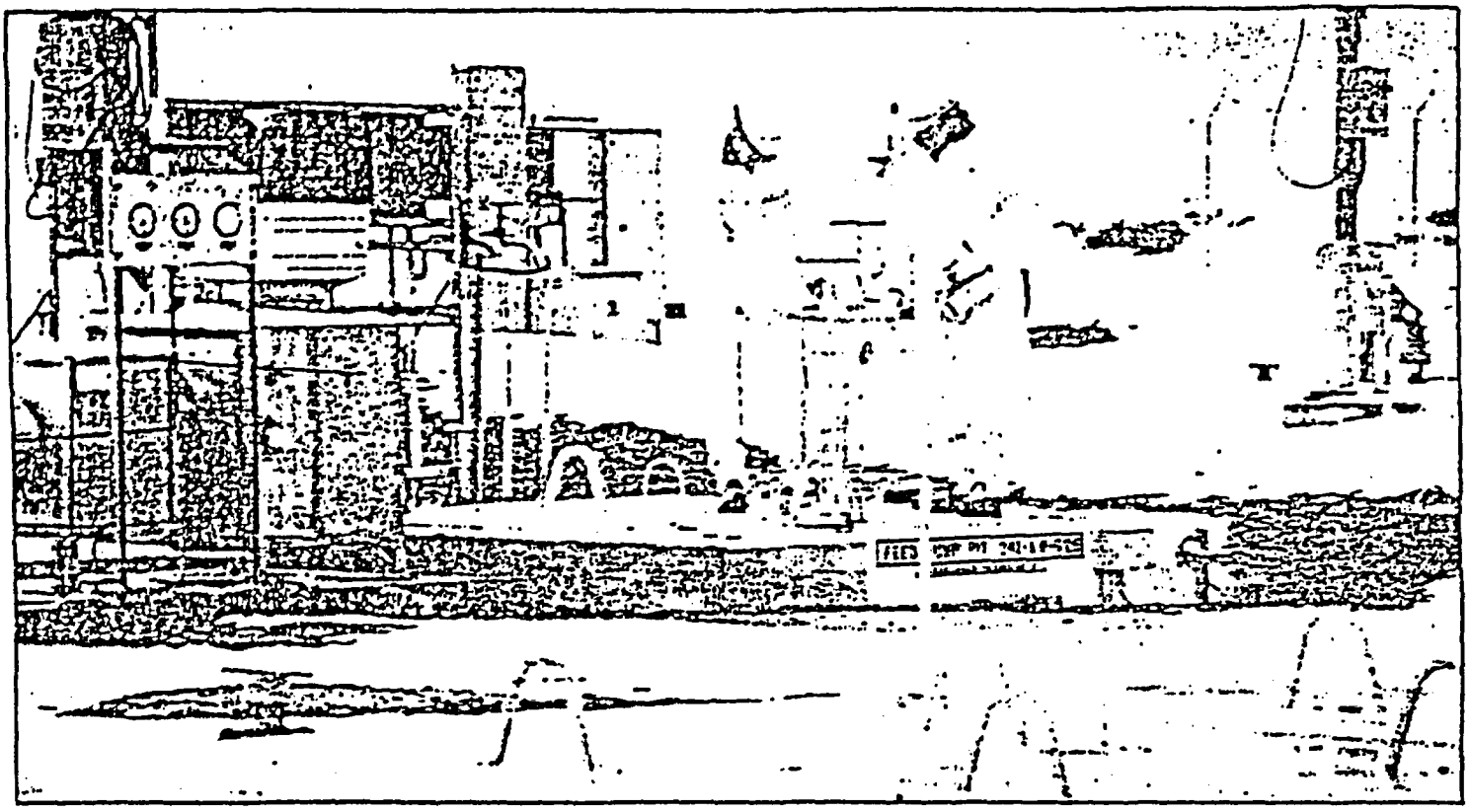
"I remember the attitude during the '40s," said William F. Heine, waste management program manager for Rockwell Hanford Operations, the government contractor that handles Hanford waste. "When your national life is on the line, you don't worry about environmental concerns."

The Hanford managers say conditions have improved markedly since then.

"We don't think there is any real measurable effect at all on the public from our operations," said Jerry D. White, director of the Energy Department's Richland Operations Office waste management division.

But the fundamental conditions that created

TOR
MAY 1 3 1995
Pg 2 of 8



The Oregonian/CLAUDIA J. HOWELL

WATCHING THE WASTE —Workers monitor buried double-walled tanks containing highly radioactive acids remaining from bomb-making at Hanford Nuclear Reservation. Southeastern Washington complex already is world's largest nuclear dump.

Hanford's worst accidents still exist today.

Weapons plants continue to create a variety of poisons, filling the dump still fuller with substances that are stored temporarily. To produce increasing quantities of plutonium and uranium for warheads, Hanford's N reactor and PUREX plants last year generated 137,700 cubic feet of contaminated solids and 312 million gallons of liquid radioactive waste, Heine and other officials said.

The 4 million-gallon portion of that liquid that is highly radioactive rests in huge, double-walled tanks. Those tanks have replaced single-walled tanks that have leaked liquid bearing 250,000 curies of radioactivity, contaminating about 3 million cubic feet of soil, White said. A curie is a measure of radioactivity, equal to 37 billion disintegrating atoms per second.

The less radioactive liquid is poured directly into the desert ground. Some of the substances have stayed so far in nearby soil, where Hanford managers predict they will remain. Other radioactive and chemically hazardous materials have been found to enter ground water reaching the Columbia River, which runs through the site.

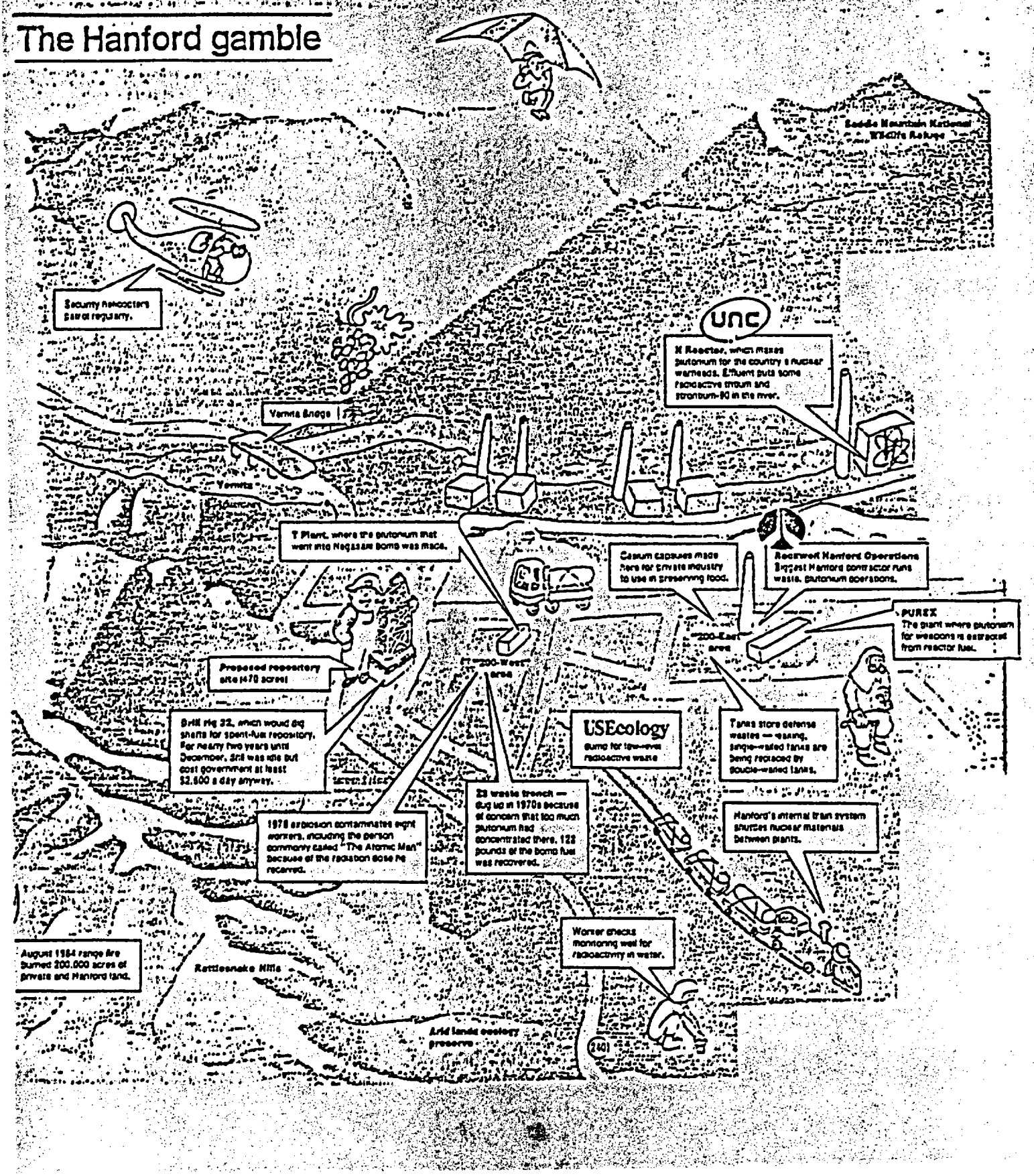
In the absence of independent monitoring, no public health effects have been documented conclusively from the radioactive waste at Hanford.

But — with or without a spent-fuel repository at Hanford — should the need arise to decontaminate the area, no one could do much short of turning back the clock.

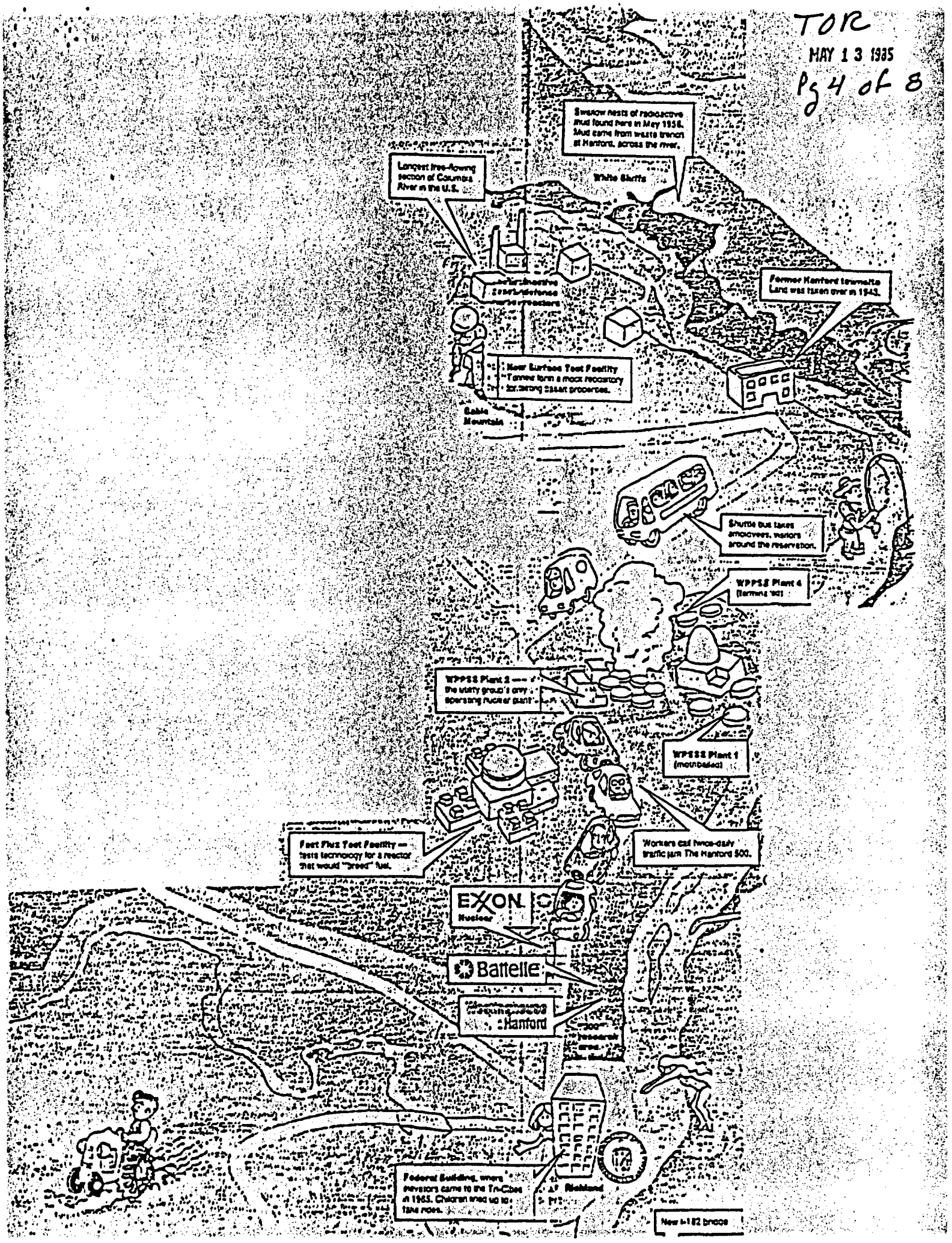
Additional details on Pages A4,5.

THE OREGONIAN
Portland, OR
MAY 13 1985

The Hanford gamble



TOR
MAY 13 1985
Pg 4 of 8



THE OREGONIAN
Portland, OR
MAY 13 1985

Hanford's atomic complex

RICHLAND, Wash. — Each week, an average of 35 travel-worn truck drivers complete a pilgrimage to a desolate reach of the Hanford Nuclear Reservation's sagebrush flats.

The trucks bear barrels of contaminated cloth, dirt, wood, laboratory animal carcasses, asphalt and resins that are covered by the catchall term of low-level radioactive waste. They come from hospitals and research laboratories and nuclear plants all over the country to have their cargo dropped into one of only three gigantic pits in the nation that legally will accept it.

The 4.8 million-cubic-foot pit, and 12 others already filled and covered with earth nearby, constitute the country's fastest-growing commercial nuclear dump. The private U.S. Ecology dump is only a small part of a map of the Southeastern Washington atomic complex, which covers 570 square miles.

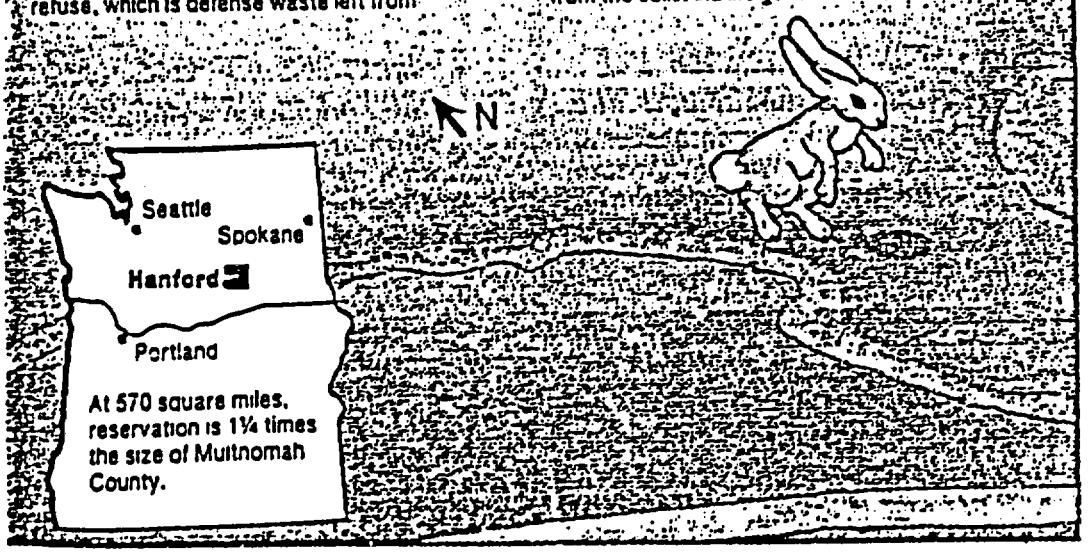
Nearby, two federal nuclear dumps contain the lion's share of the reservation's radioactive refuse, which is defense waste left from weapons-making. Watching over the waste presents problems, but the waste-handling record is improving, Hanford officials say.

The reservation also contains N Reactor, where the raw material of U.S. nuclear bombs is generated, and PUREX, where the reactor's spent fuel is reprocessed into plutonium.

The bird's-eye view at right shows other Hanford features, which include everything from a test breeder reactor to the drill that might one day begin tunneling a tomb for 77,000 tons of waste from the nation's nuclear power plants. The spent-fuel repository would be carved from basalt 3,200 feet underground and four miles south of the Columbia River.

The national spotlight that accompanies the repository proposal hasn't changed life for the 144,000 residents of Benton and Franklin counties in the area known as the Tri-Cities.

The afternoon drive home still means a traffic jam. Fishing and boating are popular sports both with the locals and with tourists. Farmers coax wheat, apples, potatoes and wine grapes from the soil. And life goes on.



TOR
MAY 1 3 1985
Pg 6 of 8

Arms race leaves legacy of radioactive wastes

Second in a series

By RICHARD READ
of The Oregonian staff

RICHLAND, Wash. — Thousands of miles removed from the arms negotiation table in Geneva, and still more miles and years away from the world's first atomic battlefield, millions of gallons of radioactive refuse remain from four decades of weapons-making on a Southeastern Washington plateau.

Contaminated acids five miles from the Columbia River on the Hanford Nuclear Reservation are a direct consequence of America's 40-year commitment to building the world's biggest nuclear arsenal. Whatever the ramifications of that buildup, the wastes are its indisputable legacy.

As darkness fell on the heart of the nuclear dump recently, nuclear operator Don Parchen finished pumping stray rainwater from a well used to monitor radiation in soil around buried tanks. Technician Carla Burnham ran a quietly sputtering radiation detector across Parchen's face in the deliberate way a barber might maneuver an electric razor over the jowl of a finicky customer.

Not a word passed between the two. It was as if silence might hasten refuge from the cold desert air that hung over the largest collection of nuclear waste anywhere.

The Rockwell Hanford Operations employees had reason to take care.

They stood at a chain-link fence that bars radioactive T-tank farm from the same public that the bombs necessitating its creation were meant to protect. In that farm, from tank 106T, about 115,000 gallons of poisonous stew once spewed undetected into Hanford soil.

That incident in 1973 thrust the Hanford dump into the spotlight. The public gaze remains uncomfortable for Hanford, but it's a scrutiny increasingly difficult to avoid as more people enter the debate over the status of huge volumes of dangerous waste generated from manufacturing weapons-grade plutonium.

Guardians of the defense waste say they can keep the radioactive dragons in Hanford dungeons, and they resent the common descriptions of the waste stockpile.

"You call it an atomic dump," said Jerry D. White, U.S. Department of Energy Richland Operations Office waste management division director. "The word 'dump' has a negative connotation, and as long as the media calls it an atomic dump, it doesn't matter what else you say."

Call it what you will, the region where most Hanford waste is stored is split in two and known for security reasons by unpretentious numerical names — 200-East and 200-West.

"When they built the site, they thought the Japanese might bomb it, so they built two areas, each self-sufficient," said William F. Heine, Rockwell's waste management program manager, on a recent tour.

The collar of Heine's trench-coat flapped in a breeze as he walked past posted and patrolled pits filled with solid radioactive waste. Behind him on a low bluff stood a drab, concrete building named T Plant.

The windowless structure, now awaiting decontamination, at one time bustled with workers producing the plutonium used in "Fat Man," the bomb dropped on Nagasaki, Japan. Nearby stood Redox and U Plant, gray warhorses that produced more bomb material and more liquid waste before turning into waste themselves.

Hanford managers say the reservation's waste handling has improved vastly, radiation released is insignificant and the atom is safe when properly harnessed.

"Radioactive materials are a part of everyday life, and they've been a part of the universe since the day the universe began," said Michael R. Fox, a staff engineer in Rockwell's waste management program. "There are many, many beneficial uses of radioactivity."

Those tenets pervade the working community of the "200" areas, from higher-ups such as White and Fox down the chain to people such as Otis W. Dennis, who supervises a team of waste-tank workers. Dennis, 64, is a man so careful that he checks his car's oil level and notes the pressure in all four tires each day before driving off to work among tanks brimming with highly radioactive liquids.

Dennis packs his lunch in a box that belonged to his father, a Montana miner. The World War II Marine Corps veteran is convinced that his job is safer than mining and that the tank farms offer less risk than Portland traffic.

"I'm proud to be out here," said Dennis, who will retire next year after almost four decades. "I wish I could spend another 30 years here. I mean it."

Critics of Hanford's waste management practices see another side. Joan Mootry of the Hanford Education Action League, a citizens group studying health effects of the reservation, believes a dump by any other name is still a dump — and a threatening one at that.

"Hanford's made trouble for the whole Northwest. I'm afraid," Mootry said. "Sadly, we can't see it, feel it or touch it, but it touches us."

Many people's perceptions about whether Hanford waste practices are objectionable hinge on their opinions concerning nuclear technology, a subject on which few people are neutral. To Hanford workers, the dump's risks are particularly innocuous considering benefits derived from Hanford products.

"If that bomb hadn't gone off, I wouldn't be setting here," said Dennis.

But Robert J. Alvarez, radiation program director for the Environmental Policy Institute of Washington, D.C., said that even after setting the nuclear arms debate aside, he believed Hanford ran a "primitive" waste storage operation.

"If you have a major rupture of the tanks up there, you might as well write off the Columbia River," he said. "It would be a veritable radioactive hell in the center of that area."

That is hotly contested by Hanford managers, who say Battelle Pacific Northwest Laboratory research shows nothing would reach the river even if all the tanks leaked.

An inventory of the world's largest known atomic dump includes the following:

- One hundred and forty-nine buried single-walled tanks, some that bear radioactive stew as hot as 200 degrees Fahrenheit. Officials have lost track of the radioactive and chemical makeup of contents of the old tanks, 60 of which are classified "assumed leakers."

In 1973, when The Oregonian, with the help of a group of knowledgeable scientists, investigated tank leaks, Atomic Energy Commission officials predicted waste would be solidified by 1976 to prevent further leakage. But today, Energy Department officials say the job will take until 1989 to complete.

- Twenty double-walled tanks, one that "burps" contained vapor once a month. These improved underground tanks, built after corrosive liquid breached older tanks, are for waste generated by active weapons plants. Eight more are being built.

• One hundred and twenty "cribs," which are gravel-filled trenches containing perforated pipes. The cribs are used to filter hundreds of millions of gallons of low-level radioactive liquid each year into soil about 250 feet above aquifers leading to the river.

For years, various federal and state agencies have urged a halt to the use of cribs. Hanford managers say many of the more dangerous radioactive substances bind tightly to the desert soil, and they claim the area's scant 7 inches of annual rainfall provide too little "drive" to move the material anywhere before its radioactivity falls significantly. Critics, however, contend that the millions of gallons of water pumped into cribs each year push poison toward the river.

• Two ground-water "mounds" thought to result from the cribs. One reached a peak height of 60 feet above the natural water table in 1961, according to a 1975 report. George L. Toombs, an Oregon Health Division health physicist who has studied radioactivity in the Columbia River, said Hanford should have a plan of action in case massive contamination began to move toward the river. Rockwell's Heine said such movement wouldn't occur because workers would stop pouring waste into cribs when ground-water monitoring revealed elevated contamination nearby.

• Total irreversibly contaminated ground of 2,000 or 6,000 acres, depending on which Energy Department estimate is used. Hanford managers say it would be all but impossible for radioactive material to reach "criticality" — the point at which a nuclear explosion would occur — but recent Energy Department documents speak of the need for "criticality analysis" of solid waste and contaminated soil.

• Twenty miles of encased pipes that crisscross the "200" areas, circulating liquid waste. Another 200 miles of pipes are left from previous operations, during which leaks of up to 36,000 gallons occurred.

• More than 200,000 on-site shipments of waste that occur each year in trucks and trains, which rest on sidings named "Mary" and "Susie" and the like after Hanford secretaries.

• One hundred emissions stacks, half of which release measurable radioactivity into the air.

• A "plume" of tritium, or radioactive hydrogen, that emanates from the "200" area cribs and contaminates almost 100 square miles before entering the river. Hanford officials say the plume produces no significant radioactivity in the Columbia, but their methodology is disputed by Norman Buske, a Search Technical Services consulting physicist in Davenport, Wash., who has monitored the shoreline springs for the environmental group Greenpeace.

• A larger plume of nitrate that has spread through Hanford's unconfined aquifer. Hanford officials again insist levels in the river are below drinking water standards, but state officials are pushing Hanford to measure other chemical contaminants, such as zinc, copper, lead and organic solvents, which also have been disposed in the desert soil.

• Water basins holding more than 2,000 glowing steel capsules of cesium-137 and strontium-90, intensely radioactive substances separated from liquid waste to reduce boiling time of waste from 85 years to six years.

• About 1,100 workers in a waste management program that cost $80 million in fiscal 1985 and will cost $99 million a year by 1987. Workers incurred 137 skin contaminations last year in the course of 540,000 entries into radiation zones.

• Altogether eight Hanford reactors, 50 buildings and ancillary structures, 16 emissions stacks and 41 tanks, vaults and weirs awaiting decontamination and decommissioning. In addition to radioactive debris, the reactors contain lung-cancer-causing asbestos that probably will stay at Hanford.

• Open ponds holding potentially contaminated cooling water. Five ponds have been filled with clean soil and plants.

• A computer surveillance system that keeps track of waste, taking more than 3,600 readings per day.

The waste stockpile upriver and 150 air miles from Portland includes non-radioactive junk, too. In 1983, more than 5,000 cubic feet of "dangerous" chemical waste was buried at Hanford. Now at least 100 drums of "extremely hazardous" waste are being stored temporarily since a dump in Arlington stopped accepting such material.

THE OREGONIAN
Portland, OR
MAY 13 1985 Pg 7 of 8

Hanford generates 360,000 gallons of sewage a day. A 30-acre conventional trash heap has accumulated since 1973, and extremely hazardous waste was dumped there until 1982.

And the dump keeps growing. Last year, 45,000 cubic feet of radioactive solids were shipped to Hanford, supplementing waste produced by the reservation's plants. Amounts of waste from afar, which include classified quantities from the Rocky Flats nuclear complex in Colorado, are expected to increase by almost a third this year.

The U.S. Navy contributes contaminated submarine core barrels to the government's "200" area dumps, and reactor cores from 100 nuclear submarines may eventually be barged up the Columbia River and buried near similar material from Hanford's Fast Flux Test Facility. And Hanford expects a barge bearing the core and vessel of the nation's first commercial reactor, along with additional debris from shutting down that plant in Shippingport, Pa.

The nation's fastest-growing commercial dump for low-level radioactive waste also is at Hanford, just down the road from the government dump. Stephen A. Carpenter, U.S. Ecology dump manager, oversees four cranes that drop barrels and boxes willy-nilly into a trench there in contrast to the government's careful stacking of defense wastes.

Carpenter said the jumbled junk "compacts better" than stacked trash. George R. Kolbenschlag, assistant to the president for public relations at U.S. Ecology, could describe the 20-year accumulation only by volume.

"No one knows with any accuracy exactly the number of curies and exactly the different isotopes that have gone in there," said T.R. Strong, Washington Department of Social and Health Services radiation control program director, who has worked to monitor the site more closely as years go by.

Nevertheless, a 1981 Energy Department inventory estimated a total 950,000 curies of material present at time of disposal at the U.S. Ecology dump. A curie is a measure of radioactivity, equal to 37 billion disintegrating atoms per second.

A 1983 U.S. Nuclear Regulatory Commission inventory noted the presence of nearly 100 pounds of dispersed plutonium there. Like the federal dump, U.S. Ecology's dump includes chemical waste — about 17,000 cubic feet buried before 1970.

It was only 10 years ago, after environmental groups filed a federal suit against the Atomic Energy Commission, that the government lifted a curtain of secrecy to describe the contents of its dump. A 3-inch-thick, canary-yellow document issued by the U.S. Energy Research & Development Administration, called report 1538, provided inventories and descriptions that fell short of the plaintiffs' expectations but presented the most complete picture to that date of Hanford's waste management.

"Since ERDA 1538, there has only been one significant unplanned release," Heine said, noting a pipe that leaked cesium-131, strontium-90 and plutonium-239. Heine has been directing a program to clean up old spill sites.

Ronald D. Prosser, Rockwell's waste management director, said the dump's operations have improved immensely since the old days, and he said he would like to minimize the use of tanks and cribs.

"Waste management has gone through a considerable ratcheting over the last 30 years here at Hanford," Prosser said. "We monitor the hell out of our environment, and it does compare very, very favorably with anywhere else in the Northwest as far as air quality and water quality."

Hanford managers have launched an aggressive public relations campaign to improve the image of their dump.

"It's kind of like Hitler's big lie routine, you know," Prosser said of the criticism. "If you hear it enough times and enough times and enough times, sooner or later people are

TOR

MAY 13 1985

Pg 8 of 8

going to believe that it's true. I don't know if we can change that in the near term, but we can sure start getting out and talking to people."

However, others outside Hanford have a different view of the dump.

"I think clearly it's something that is unacceptable in its present configuration," said David Stewart-Smith, a radiochemist who manages the Oregon Department of Energy's radioactive materials program.

Barbara A. Finamore, a lawyer with the Natural Resources Defense Council in Washington, D.C., said she thought it was "only a matter of time" before wastes in the ground traveled off the Hanford site. And Dick Nelson, a Democratic state representative from Seattle and a former Battelle engineer, said he thought Hanford's waste management record did not bode well for safety of a deep geologic respository there.

Rockwell and Energy Department officials said repository plans and managing existing wastes were separate issues.

NEXT: Profile of the Tri-Cities.

THE OREGONIAN
Portland, OR
MAY 1 4 1995

B-8
Pg 1 of 5

The Hanford gamble: The place

Pride, nuclear economics bolster life in Tri-Cities

Residents grew up with atom

Third in a series

By SPENCER HEINZ
of The Oregonian staff

RICHLAND, Wash. — David A. Harrow finishes his toast and orange juice. He says good-bye to his wife, Lisa, and 9-month-old son, Matthew.

He drives to work at the Hanford Nuclear Reservation, where he spends another shift packaging plutonium for nuclear warheads.

At the age of 24, Harrow helps workers at shielded stations tape lids onto cans of plutonium oxide, a heavy dark green powder that can be sparked into a death flash with the power to level cities.

"I don't think from a day-to-day basis that I'm working on plutonium for bombs," he says. "I think I am working on my nation's defense. And I'm proud of that."

After work, he drives back home for dinner. And the duality of this lifestyle is played out daily by Harrow's two dozen colleagues on the plutonium oxide line and about 13,500 other employees in various other jobs on the reservation.

Straddling the Columbia River near the Tri-Cities, upstream and 150 air miles from Portland, Hanford occupies a windblown patch of desert scribbled with loops of security wire and peppered with coyotes, jack rabbits, retired wartime atomic reactors and nuclear production plants protected by guards in camouflage gear.

Hanford, which sprawls over 570 square miles of Southeastern Washington, embraces one of the biggest arrays of nuclear activities in the United States.

And Hanford is backed by one of the wealthiest, most educated, most churchgoing and most proudly pro-nuclear populations in the United States. The Tri-Cities is where a Holiday Inn serves a sandwich called a "Meltdown" and where a high school team calls itself "The Bombers." The painting of a mushroom cloud on a ballpark sign provides psychological sustenance.

The Tri-Cities, in other words, has an atomic underpinning. Focusing on that alone, however, produces a distorted picture. The Tri-Cities has more in common with other U.S. cities than it has in contrast. A visitor is at least as likely to see the children in the playground, the men pumping gasoline and the farmers caring for the land as he is to chance upon someone who makes plutonium for a living.

Yet there is no denying that the Tri-Cities is different because it so routinely accepts life with the atom. The mushroom cloud and other nuclear illustrations are not political statements designed like peace symbols to persuade; they are simply background like the area's sagebrush and jack rabbits and cotton candy clouds.

While the nuclear symbols may strike cynical outsiders as profound harbingers of a doomed civilization, they strike many residents as nothing worth fearing and a source of community pride. They grew up with the atom. The atom grew up with them. They are mutual caretakers. "Pro-nuclear" is a political label invented by outsiders, and it has no context in a land where nearly everyone is.

"It's a non-issue," said a Richland automobile salesman, Del L. Hivley. "Nobody's afraid of it, or they wouldn't live here."

Karen J. Wheeless splits hairs.

"We don't make bombs here," she said. "But we do make plutonium which is going to be used in bombs."

Wheeless is a public affairs specialist with the Richland Operations Office of the U.S. Department of Energy, which manages Hanford from Richland's Federal Building three miles away. A slide projector hums, and she handles the play-by-play description:

Hanford scientists do biomedical research on pigs, beagles, rabbits and calves. About 60 percent of Hanford employees carry the highest security clearances. Hanford has its own electricity, water, police, fire and bus services. Hanford workers are sincere, patriotic and often religious.

"In their heart of hearts, they really believe they are doing the right thing," she said. "It's really hard for them to believe anybody would disagree with that."

She gets into a van and aims for the reservation. There are no curves for miles. Deer zap across the highway and vanish into a buff-colored world.

The Hanford site — known casually as "the area" to the two generations of fathers and mothers who have worked there since it produced the Nagasaki plutonium — today embraces this atomic cocktail:

- A 400-person security force equipped with explosives-sniffing dogs, helicopters and Uzi submachine guns.
- A disposal site for 60 percent so far of the nation's high-level radioactive weapons-program wastes (as opposed to commercial nuclear power plants' spent fuel, 77,000 tons of which would go to Hanford if it is named the

TOR
MAY 1 4 1985
Pg 2 of 5

nation's underground repository).

• Top-secret plutonium-production and experimentation plants.

• Three of the five Washington Public Power Supply System nuclear power plants.

• A swine barn for holding a strain of pigs — one-fifth normal size — produced at Hanford for biomedical medical research.

• A 120-square-mile arid reserve that is monitored for the effects of nuclear activities on wildlife.

The U.S. Department of Energy expects to spend a record $975 million this year to cover Hanford operations. That is part of the $7.05 billion that the Energy Department has spent on Hanford activities since 1975. The money is distributed among eight government contractors who either do the work themselves or have it done by hundreds of subcontractors throughout the nation.

The largest Hanford contractor, Rockwell Hanford Operations, does everything from run the PUREX (plutonium-uranium extraction) plant where David Harrow works, to stock the entire reservation each month with 7,500 rolls of toilet paper, 5,000 black felt-tip pens and 4,000 frozen TV dinners for the people who work overtime.

Hanford is half the size of Rhode Island and 1¼ times the size of Multnomah County. But it contains buildings on only 30 square miles. Some plants run 24 hours a day. Most workers commute by bus, up to two hours a day. They call the rush hours "The Hanford 500." For those who work in the nuclear outback, there is "isolation pay" — $10.99 a week above regular wages.

They are well-paid. Incomes range from about $25,000 a year for the blue-collar workers through about $70,000 for a few top officials. The highest paid Energy Department employee is the department's Hanford chief, Michael J. Lawrence, who receives $70,500 a year.

They work in a wonderland of acronyms — in places called PUREX or the FFTF or the NSTF, which stand for Fast Flux Test Facility and Near Surface Test Facility.

There is a public relations filter. While teams of public relations officers work diligently to share information with outsiders, they also work dependably to control which information that will be. National security, economically valuable research information and Hanford's public image are among the items at stake.

Paul R. Loeb — the Seattle-based author of "Nuclear Culture," a study of Hanford — wrote recently that he believed community dependence upon government contract work blocked open debate with "firebreaks of job loss, fear and security mystique. ... The weapons culture demands loyalty, not only of its employees, but of the community that benefits economically from the military presence. Absence of loyalty is equated with disloyalty to the home team — even treason."

Although the Hanford environment can leave outsiders feeling topsy-turvy, individuals within that system generally seem sincere about their work.

Henry B. Spitz, a senior research scientist at Battelle Pacific Northwest Laboratory at Hanford, said that he was committed to keeping Hanford safe and that he was a peace marcher in the 1960s.

"I'm not for war by any means," he said. "On the other hand, this is going to sound like a cliche, but having this stuff (plutonium) in your back pocket is something that could help keep peace. ... That's how I rationalize my work here.

"I strongly believe we are never going to use this stuff. We'd be insane to use it."

Three miles south of Hanford is the downtown core of Richland, a 31,660-person bedroom community in the area known as the Tri-Cities. It is a gathering of interests that also embraces Kennewick, a business center with a population of 37,240, and Pasco, a largely agricultural population of 18,930.

Hanford also is 13 miles northeast of the 4,000-person Yakima Indian Nation reservation, which has taken a position that Hanford would not be a safe burial ground for the nation's nuclear waste.

Within the Tri-Cities itself, there is not such organized opposition. Money is money, and the Tri-Cities, which was nursed on the atom — and recently starved by the WPPSS plant shutdowns — is a community in need of a transfusion to maintain its standard of living.

The local residents are trying to diversify. Dean T. Schau, a labor market economist with the Washington State Employment Security Department, said the Tri-Cities area already was arguably the french-fry capital of the United States, the biggest meatpacker in the Northwest, a large paper-maker and a significant producer of wines.

Schau said Hanford's $975 million annual budget produced by far the biggest fiscal impact on the Tri-Cities. Agriculture is important, but nuclear work and other Hanford research was critical to the Tri-Cities. The area's residents give the atom their allegiance.

All except for the few such as Larry Caldwell.

Caldwell is a former Hanford worker who now is Richland's resident activist. He takes visitors on what he calls "The Tacky Tour." He points to the atomic symbols on the furniture store and at the cemetery, and he worries about communities that stop asking questions.

"There's two things," he said, "that raise havoc here — if you try to change around cable TV stations and if you try to change anything about the local dog pound. Then you talk about trying to bring a waste repository in here, and there's no question, no debate, no nothing."

Caldwell stops to consider Central United Protestant Church, the outer wall of which features sculptured metal tracings of classically graceful humans floating past atoms the size of small grapefruit. The church once used this slogan: "Where the atom is split, the churches unite."

"You pledge your fealty to the atom," Caldwell mused, "and the atom protects you."

Associate Pastor Robert R. Roberts said production of bomb material was not particularly an issue among parishioners. His church ranks in the top 1 percent nationally of Methodist churches in terms of Sunday attendance, which runs about 1,100, he said. Although he acknowledged knowing little about nuclear work at Hanford, he added that he trusted the Hanford experts who placed their trust in God.

"It's really a profound faith that I find here," he said after eight years in the parish. "In fact, my own faith is much deeper than it was eight years ago because I have had the opportunity to rub shoulders with these people."

Across the street, the Rev. Richard A. Wuertz, pastor of Christ the King Roman Catholic Church, wrestles with the questions.

"I could get up and rail constantly against the nuclear menace and thus lose my ability to minister to these people," he said. "And yet I still have to maintain my own integrity, as a representative of the bishop and as a priest of the gospel, to really be the prophetic figure and to see the situation as it is and to speak to it. My fear

THE OREGONIAN
Portland, OR
MAY 14 1985

would be to be so prophetic in that matter as to lose my ability to minister and to be written off as an anti-nuclear nut."

He said he personally supported Hanford's plutonium operations with the understanding that they may prevent war.

"Peace has to be the ultimate goal," he said.

—

The more immediate goal is for the local residents to keep their jobs, and that is the charge of Sam Volpentest.

At the age of 80, Volpentest — who is executive vice president of a nationally influential lobbying force called the Tri-City Economic Development Council — remains perhaps the most personable and visible booster for the Tri-Cities. Like other community leaders, he supports Hanford because he trusts the people who insist it is safe, Volpentest said.

"I am as concerned as anyone else here, as a Larry Caldwell or as anyone else," he said. "And if for a moment I thought anything at all was wrong out there, I'd be the first one to yell, and if I yelled, people would listen."

There is some economic pressure not to yell.

Tri-Cities unemployment has ranged from 11 percent to 15 percent during the last three years, ahead of a national rate that averaged 9.6 percent in 1983 and was 7.3 percent last month. The community just got a new freeway system, and now there is not much traffic. Volpentest points out the window of his Oldsmobile to a shutdown shopping mall in Kennewick. "Look at that. Completely empty," he said.

Full of hope for the future, he blames the present problems on too many apples in one atomic barrel, historical jealousies among the three cities and construction stops on WPPSS plants.

"When they had the shutdown," he said, "everything went to hell."

Volpentest often works on community development projects with Glenn C. Lee, former publisher of the Tri-City Herald.

Such close alignments over the years have brought charges from critics that even the local newspaper served as a tool for promoting Hanford activities without carefully examining the associated potential health risks to the Northwest.

"I'm not going to say that the Herald didn't promote — we did," said William R. Klink, a former Herald managing editor who now works as a Rockwell Hanford public relations officer. "But when we found mismanagement and union problems and scuttlebutt, we did that, too. We did both."

Kelso Gillenwater, who became Herald publisher in 1981 after its 1979 purchase by McClatchy Newspapers of Sacramento, Calif., said a paper that in the past was simply "a fearsome advocate" of Hanford and nuclear power now carried editorials that urged the federal government to address specific safety concerns at Hanford before selecting a national spent-fuel repository.

It either annoys or amuses him — depending on his mood — Gillenwater said, when outsiders "discover" Hanford and describe the community as a bastion of mindless, pro-nuclear rubes rather than a concentration of world-class nuclear authorities who must consider the risks and benefits of whatever they do.

But when asked whether they support Hanford's consideration as a landfill for up to 173,000 tractor-trailer truckloads of radioactive waste, they say they do with almost unbroken regularity.

A Tri-Cities health food clerk, Susan M. Lewis, offers the reason why:

Her father worked at Hanford.
Her neighbors work at Hanford.
Her friends all work at Hanford.
They would never let her down.

"We trust our neighbors," she said. "We trust ourselves."

NEXT: How the site would work.

A history

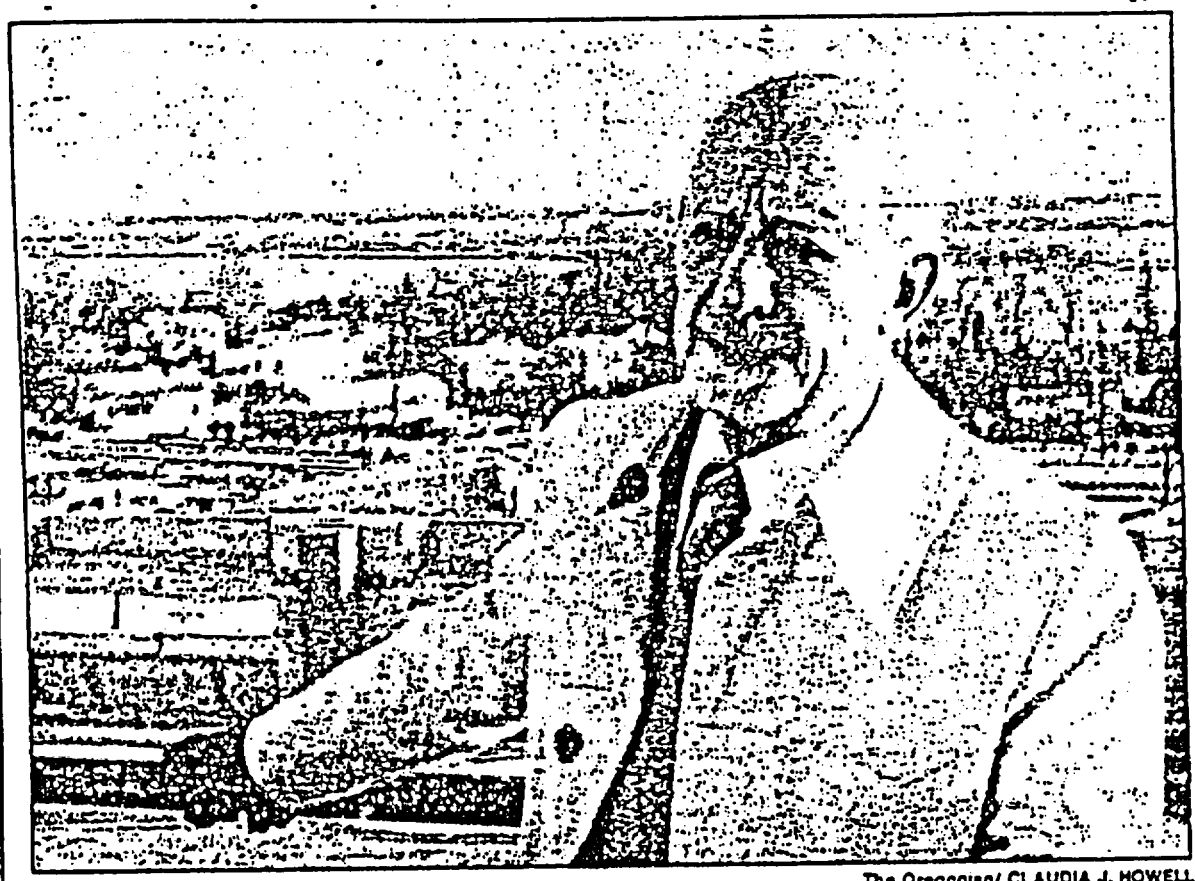
Hanford found its modern-day calling during World War II as America started work on the super-secret Manhattan Project, building the atomic bomb.

The bombs themselves would be assembled at Los Alamos, N.M., but the government needed an isolated spot to erect plutonium production reactors. And in 1943, the tiny farm town of Hanford — with cooling water from the Columbia River, plenty of electrical power from the new Grand Coulee Dam and transcontinental rail lines through nearby Pasco — became part of the wartime mission. Prominent points of its history include:

- On Feb. 23, 1943, a federal judge used the War Powers Act to order 1,500 farmers to leave the area within 30 days. The community exploded from 240 persons in January 1943 to a construction camp of close to 50,000 within months.
- On Aug. 9, 1945, the bomb carrying Hanford plutonium exploded over Nagasaki and the war was over. Not until then did Hanford workers know with certainty the nature of their mission. "OUR BOMB Clinched It!" the local paper wrote when it learned the secret.
- On July 15, 1958, the community voted to incorporate as a city. Look Magazine named Richland an "All-America City" in April 1961.
- In the early 1980s, the Washington Public Power Supply System stopped building two of three nuclear plants it had planned for Hanford, costing the community hundreds of jobs.
- The Tri-Cities still has the highest average income level in the Northwest and the 14th highest in the nation. Median family income is $30,479. The concentration of engineers and scientists is about four times the national average.

TOR
MAY 14 1985
Pg 4 of 5

The booster: Sam Volpentest



The Oregonian/ CLAUDIA J. HOWELL

When Sam Volpentest had a cancerous tumor removed from his jaw in 1957, the doctor said he had a month to live.

Today, at the age of 80, a still-vibrant Volpentest shared the secret to his survival: He said he took walks around a nuclear reactor at Hanford to irradiate his face.

"I wanted to get across the point," he said, "that nuclear is good for you."

He added that he was only joking about actually taking such walks; his point is that Hanford's atom-cracking work is nothing to fear.

"We accept nuclear power because we understand it," he said.

Volpentest, executive vice president of an influential lobbying group called the Tri-City Industrial Development Council, is a community workhorse. After moving from Seattle to Richland in 1949, he opened a Richland tavern, served as president of the Richland Chamber of Commerce, organized a local bank and helped establish the Industrial Development Council to lobby for more contracts for Hanford.

The latest challenge for Volpentest and other Richland leaders is to keep the government interested in Hanford as a potential site to bury 77,000 tons of spent nuclear fuel — but not scare off other potential industries.

Volpentest has these thoughts on:

Hanford's consideration as a national nuclear waste disposal site — "We want it to be safe. Jobs are secondary."

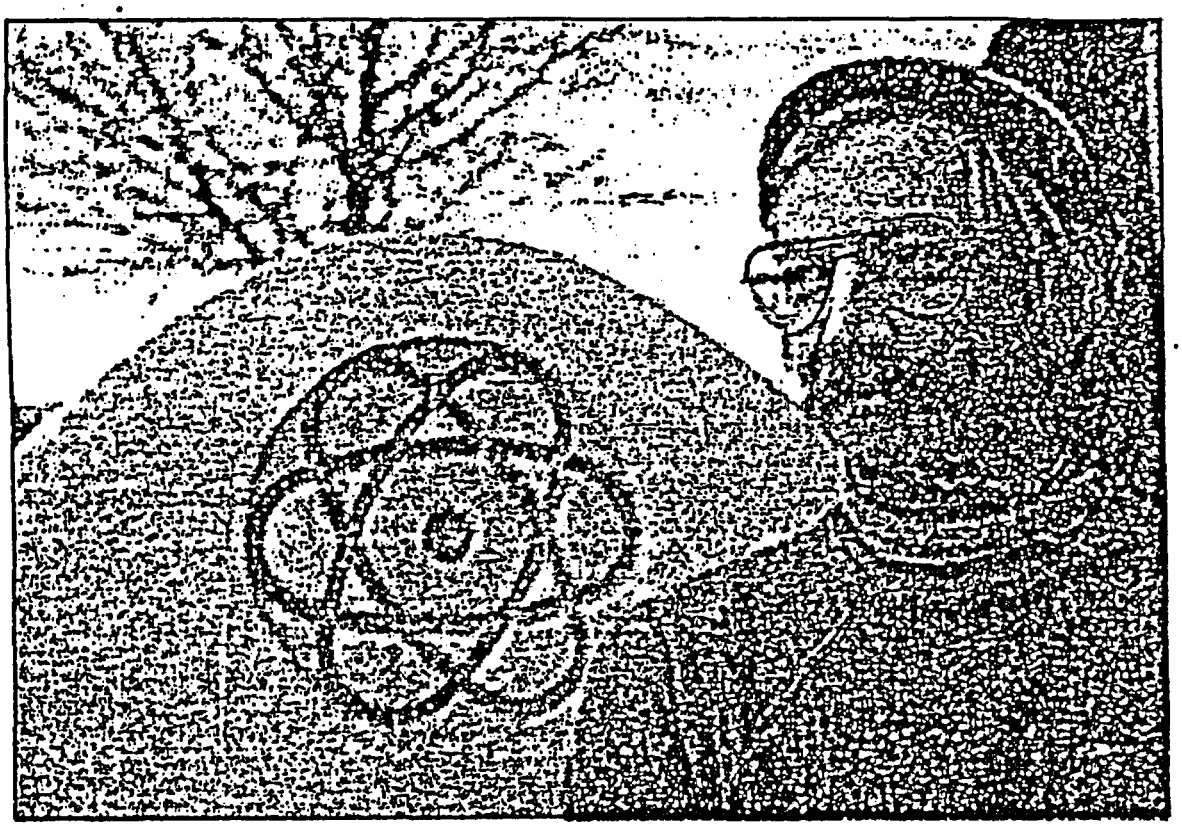
Activists who oppose Hanford's nuclear activities — "Headline seekers."

The Tri-Cities as typical American communities — "We are so misunderstood by the average person."

The painting of a mushroom cloud on a high school ballpark sign — "I don't even notice it anymore."

THE OREGONIAN
Portland, OR
MAY 14 1995

The opponent: Larry Caldwell



The Oregonian/ CLAUDIA J. HOWELL

Larry Caldwell, 43, is a member of an endangered species: He is Richland's resident activist.

If not the only one, perhaps the most straight-talking.

"The best you can say about this place is it's a cancer on the nation," he said.

Caldwell rides a Huffy that he bought many years ago for $5. Fastened to the bicycle are metal baskets. In the baskets are returnable cans that he collects to help make a living in an atomic economy.

"I not only collect cans," he said, "I collect information."

As the local member of the Hanford Oversight Committee, a Northwest coalition of religious, environmental, labor and peace activists highly critical of Hanford activities, Caldwell starts his day by pedaling to the Quik Mart to buy newspapers. Then he bicycles over to Richland's Federal Building to read any new documents on Hanford, which is where he worked until 1977 as an instrument technician. He is a repository of information.

"Everyone generally contacts me to find out anything other than what the Department of Energy tells them," he said.

When other activists pass through town, he puts them up, gives them a briefing, shows them the ropes. When a woman wanted to protest Hanford happenings, for example, Caldwell took her to the Federal Building so she could chain herself to its front door.

He visits the cemetery where his father, Shirley "Snuffy" Caldwell, lies. In 1943, Caldwell's father shipped out from Illinois as one of the thousands of able-bodied laborers who helped erect Hanford for the super-secret atomic bomb project work. Shirley Caldwell died of a heart attack in 1976, about four years after his retirement from work at Hanford.

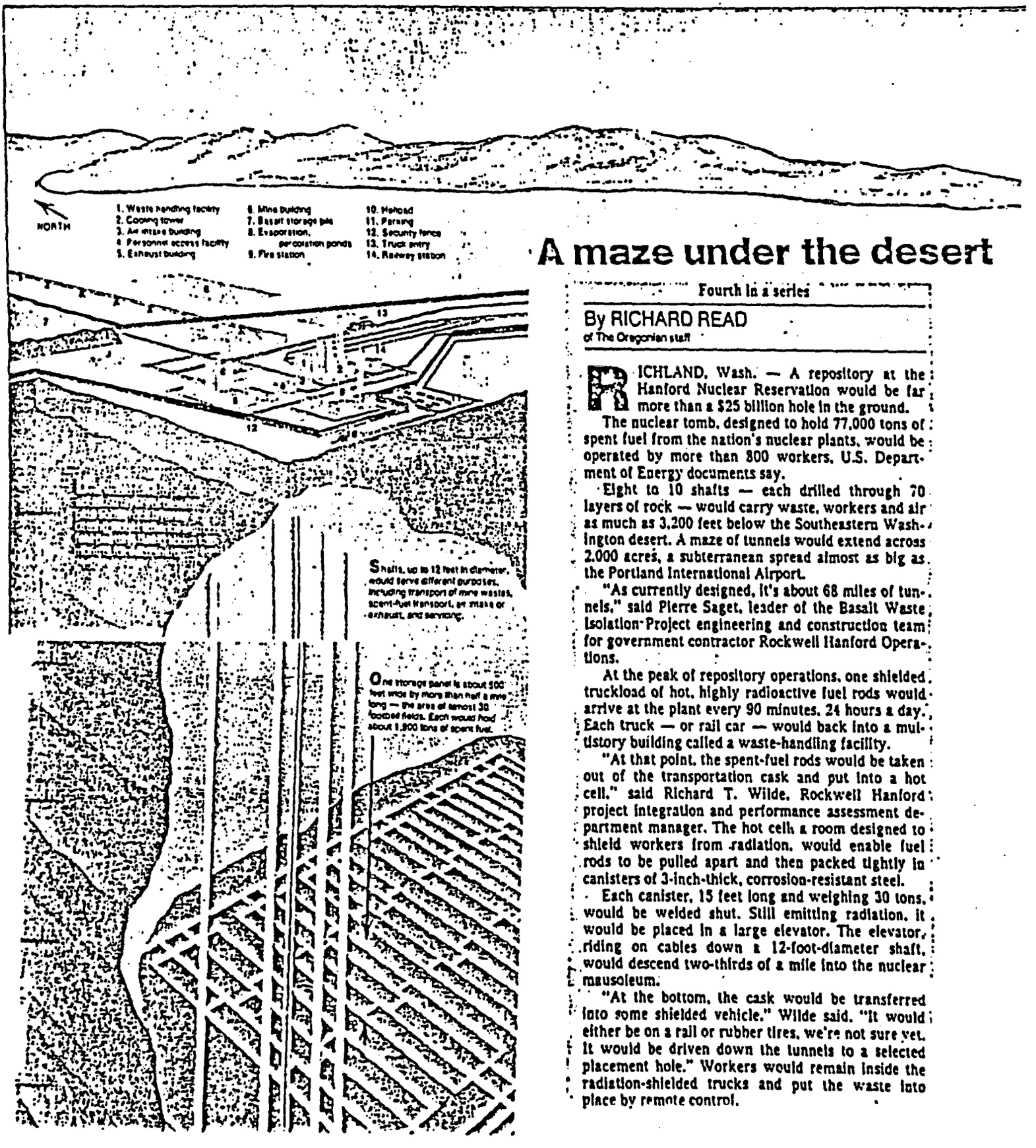
Caldwell sees his mission as doing what it takes to jog people into asking questions. He says no one has conducted a truly independent study of what Hanford may be doing to the public health. He sees that as a regional and national issue, and he believes Richland has bought too deeply into the nuclear economy to ask any questions itself. This he knows, he said, because of what happens when he stands in crowds with his protest signs.

"They've got so they don't even see me anymore," he said.

THE OREGONIAN
Portland, OR
MAY 15 1985

C-10
Pg 1 of 3

The Hanford gamble: The tomb



A maze under the desert

Fourth in a series

By RICHARD READ
of The Oregonian staff

RICHLAND, Wash. — A repository at the Hanford Nuclear Reservation would be far more than a $25 billion hole in the ground.

The nuclear tomb, designed to hold 77,000 tons of spent fuel from the nation's nuclear plants, would be operated by more than 800 workers, U.S. Department of Energy documents say.

Eight to 10 shafts — each drilled through 70 layers of rock — would carry waste, workers and air as much as 3,200 feet below the Southeastern Washington desert. A maze of tunnels would extend across 2,000 acres, a subterranean spread almost as big as the Portland International Airport.

"As currently designed, it's about 68 miles of tunnels," said Pierre Saget, leader of the Basalt Waste Isolation Project engineering and construction team for government contractor Rockwell Hanford Operations.

At the peak of repository operations, one shielded truckload of hot, highly radioactive fuel rods would arrive at the plant every 90 minutes, 24 hours a day. Each truck — or rail car — would back into a multistory building called a waste-handling facility.

"At that point, the spent-fuel rods would be taken out of the transportation cask and put into a hot cell," said Richard T. Wilde, Rockwell Hanford project integration and performance assessment department manager. The hot cell, a room designed to shield workers from radiation, would enable fuel rods to be pulled apart and then packed tightly in canisters of 3-inch-thick, corrosion-resistant steel.

Each canister, 15 feet long and weighing 30 tons, would be welded shut. Still emitting radiation, it would be placed in a large elevator. The elevator, riding on cables down a 12-foot-diameter shaft, would descend two-thirds of a mile into the nuclear mausoleum.

"At the bottom, the cask would be transferred into some shielded vehicle," Wilde said. "It would either be on a rail or rubber tires, we're not sure yet. It would be driven down the tunnels to a selected placement hole." Workers would remain inside the radiation-shielded trucks and put the waste into place by remote control.

THE OREGONIAN
Portland, OR
MAY 15 1985

The hole would extend sideways into basalt from the tunnel. The vehicle would insert the cask, then the hole would be packed with crushed basalt and bentonite clay. In all, 51,000 containers of atomic garbage would be placed during 28 years of work.

The worst radiation accident that could befall the operating repository would occur in the unlikely event that the elevator bearing a load of waste cut loose and plummeted the entire length of the shaft, cracking open to release gases, Energy Department documents say. Although the documents admit "considerable uncertainty" over the exact health effects of the fall, they estimate that a person standing nearby on Washington 240 would receive a radiation dose amounting to only a fraction of natural background levels.

Energy officials say normal repository operations would release radioactive gases within allowable dose limits, but the U.S. Environmental Protection Agency is concerned that fuel rod consolidation would emit substantial amounts of gaseous krypton-85 and iodine-129.

In the case of fire or explosion, the repository would have its own fire station at ground level in a fenced, 470-acre compound containing a cooling tower, a helipad, exhaust buildings, 700-gallon-per-minute water intake from the Columbia River, a standby generator and perhaps a visitors' center.

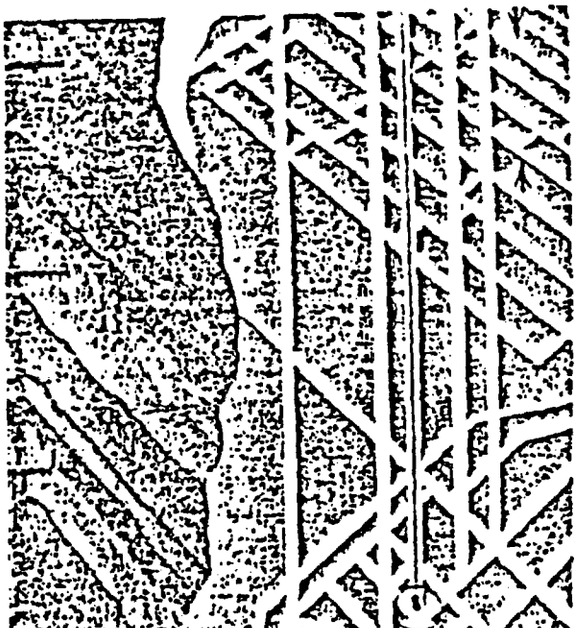
"That big pile that you see behind the surface facilities is what we refer to as the spoils pile," Saget said.

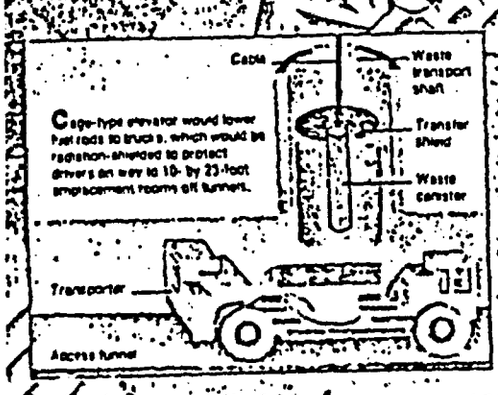
The 30-foot-high mining spoils pile would cover 60 acres, said Barry C.K. Moravek, public relations officer for the Basalt Waste Isolation Project. The pile would result from a repository construction program in which, the draft environmental impact statement predicts:

- 22 workers would die and about 1,000 more would sustain disabling injuries.
- Natural underground rock temperatures exceeding 120 degrees Farenheit would be fought with refrigeration.
- Explosive methane gas in the mine would be diluted with fresh air.
- Sudden inrushes of scalding-hot, high-pressure water would be prevented by exploratory drilling.
- Bursting of highly stressed rock would be prevented by blasting to relieve excess stress or by shoring up tunnel openings.
- Building the repository would use at least 27,000 tons of steel, 4 million cubic feet of concrete, 12,000 tons of steel reinforcing bars and nine miles of rail track.

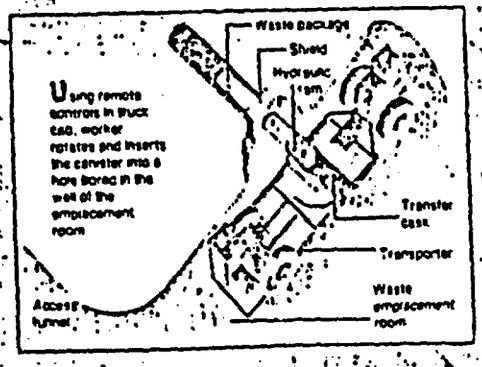
Some critics are skeptical of the feasibility of the construction task. Federal law dictates that a repository would be built at Hanford only after a site characterization effort now expected to cost about $870 million. In that six-year project, a drill would work 24 hours a day, 365 days a year to sink two shafts into the Cohassett basalt layer, which was laid down by volcanism about 16 million years ago.

A peak work force of 200 would take part in the project, which would involve mining some horizontal tunnels and conducting numerous scientific tests. If the tests convinced government scientists that a Hanford repository would be safe — and if the Hanford site finally were selected under the current schedule — the atomic graveyard would be ready in 1998 for 28 years of receiving waste.

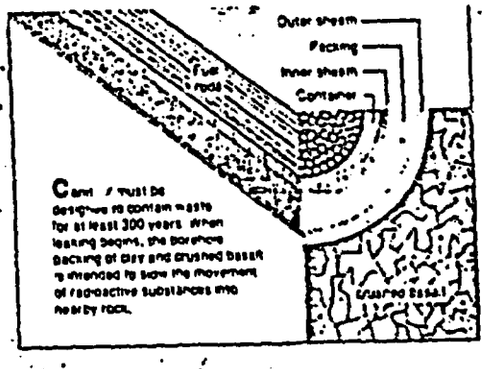




Cage-type elevator would lower fuel rods to trucks, which would be radiation-shielded to protect drivers on way to 10- by 23-foot emplacement rooms off tunnel.



Using remote controls in truck cab, worker rotates and inserts the canister into a hole bored in the wall of the emplacement room



Canister must be designed to contain waste for at least 300 years. When leaking begins, the borehole backing of clay and crushed basalt is intended to slow the movement of radioactive substances into nearby rock.

As tentatively proposed, the nuclear-waste repository would consist of 68 miles of tunnels blasted out of basalt rock, about 3,200 feet underground. Some tunnels would be used for waste transport and others for mining operations, so workers could begin placing waste into completed sections as other sections were being mined.

The Oregonian/PAUL SIEGMUND

TOR

MAY 1 5 1985

Pg 3 of 3

For at least 50 years, workers would retain the ability to retrieve the waste in case the system failed or in case Congress decided to reprocess the waste to extract plutonium for weapons or breeder reactors. Then crushed basalt from the spoils pile would be returned through the shafts to seal the repository, and the surface would be marked with warning monuments.

The U.S. Nuclear Regulatory Commission requires that the casks of spent fuel be designed to stay intact for at least 300 years.

"Right now we say that the canister ought to last between 4,000 and 8,000 years before corroding," Wilde said. After that, the design counts on basalt around the breached casks to contain the waste. Most of the waste's components would lose their significant radioactivity by that time, but a few would emit radiation for millions or billions of years.

Scientists say the extent of ground-water movement will determine whether substances will reach the human environment while still dangerous.

NEXT: How suitable is Hanford for a repository?

THE OREGONIAN
Portland, OR
MAY 16 1985

THE HANFORD GAMBLE

Is the Hanford Nuclear Reservation a safe place to bury 77,000 tons of the nation's most dangerous radioactive waste? Chief among lingering technical concerns is how quickly contaminated ground water would move toward a Northwest lifeline, the Columbia River.

Details on the Hanford site's suitability are on Pages D1, D6 and D7, in the fifth day of 15 articles in The Hanford Gamble series.

Friday: Transporting fuel rods, and more suitability questions.

U.S., Rockwell unit feel storage plan 10,000 years 'safe'

By RICHARD READ
of The Oregonian staff

Technical obstacles, many of which have been known for years, face a proposal to isolate 77,000 tons of spent nuclear fuel in water-saturated rock beneath the Hanford Nuclear Reservation.

Yet the U.S. Department of Energy and its contractor, Rockwell Hanford Operations, are continuing with research, saying they've found "no show-stoppers" to preclude the possibility of safely stowing the highly radioactive material in a deep cavern 4 miles from the Columbia River.

Numerous doubts about the ability of Hanford basalt layers to contain highly radioactive waste are raised in criticism submitted recently by more than 1,200 agencies, organizations and individuals in response to an Energy Department feasibility study.

THE HANFORD GAMBLE

Many of the same fundamental concerns crop up in thousands more pages of studies and critiques dating back to 1976, when Rockwell scientists began investigating the possibility of building a repository thousands of feet below the Southeastern Washington desert.

The exchange of assertions has begun to fall into a pattern, in which Hanford officials issue upbeat reports of the chances for mining and building a safe repository, only to suffer another barrage of sobering scientific criticism.

As the process for selecting a repository site moves toward its conclusion, agencies from the U.S. Nuclear Regulatory Commission to the U.S. Geological Survey continue to berate key conclusions of Hanford's Basalt Waste Isolation Project as "over-optimistic," "non-conservative" and "misleading." Some technical reviewers believe Rockwell has dressed up data in public reports, an observation that two former company scientists corroborate but that the company denies.

At stake is the purity of the contiguous United States' second largest river, the health of hundreds of generations of Northwest residents and the well-being of regional agriculture and other industries.

Yet, as is widely noted in recent critiques, nowhere in 1,500 pages of the Energy Department's December draft environmental assessment did Rockwell scientists attempt to gauge the full consequences of radiation reaching the river. And nowhere did the document detail a plan of action in the event the repository began to gush.

Instead, Rockwell and the Energy Department began and ended the draft report with the proposition that repository releases would stay within regulatory limits — that worst-case scenarios would be, in effect, unthinkable.

In the course of the technical debate, no one — not even the Energy Department itself — has claimed the repository will forever contain lethal substances in the waste. Multiple engineered and natural barriers — including steel canisters, clay packing material and the basalt itself — would be relied upon to slow migration of the material.

In the absence of significant evidence to the contrary, the barriers must be "assumed" to prevent contaminated ground water from moving at a speed greater than six miles in 10,000 years, according to the Energy Department's final repository siting guidelines. Hanford basalt would probably do that and more, say Rockwell scientists, who say a median of estimates predicts an 81,000-year travel time for the ground water.

That figure is strongly doubted by John J. Linehan, repository projects branch section leader for the NRC, the agency that ultimately would consider the site for licensing if it survived a proposed five-year exploration and research program. "We in turn could take the same data and come up with values down to 1,000 years," said Linehan.

Rockwell officials say the NRC misunderstands the modeling, and they adamantly defend the data collected thus far. The officials are comfortable with draft EPA standards requiring a "reasonable expectation" that radioactive substances would have less than one chance in 10 of reaching the human environment in 10,000 years.

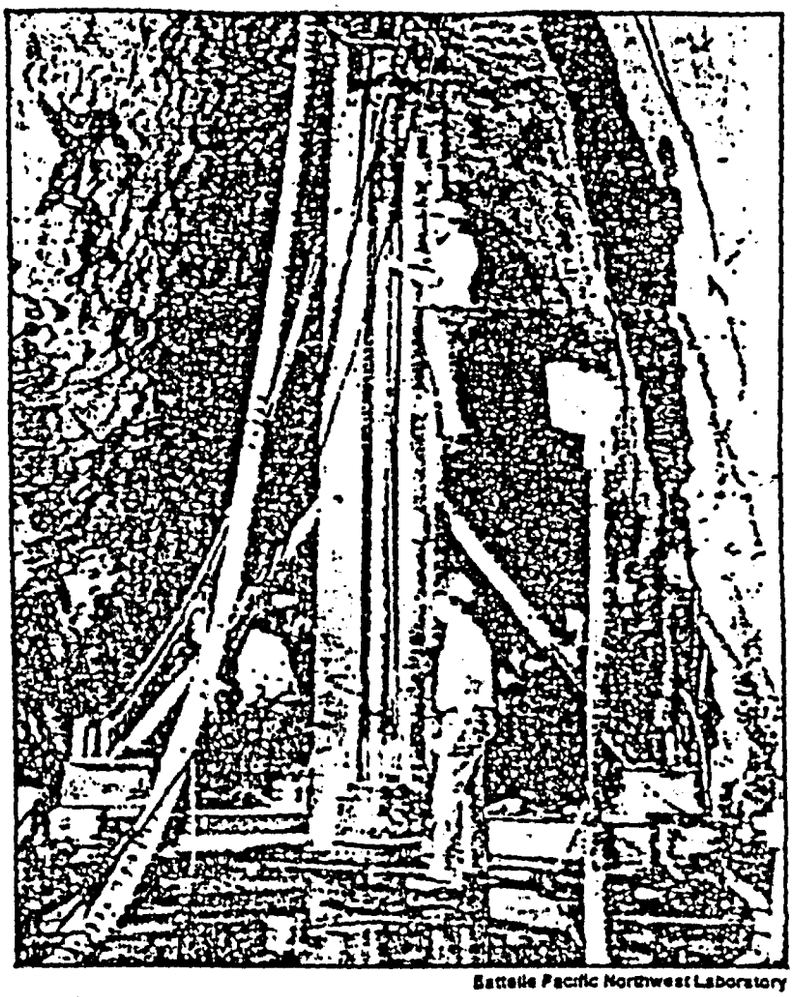
Losing the one-in-10 gamble wouldn't be so bad anyway, because the standards that would be exceeded are extremely conservative, said Ed B. Ash, Rockwell Basalt Waste Isolation Project director.

"Certainly putting nuclear waste in a repository would be less risky than keeping it on the surface," said Steven M. Baker, Rockwell's site analysis group manager for the project.

"It's a blind path that no one's been down before," said Richard C. Edwards, a geophysicist who directs Rockwell's main repository laboratory on a $4 million annual budget. "It's exciting. We probably won't know in several generations whether it worked or didn't."

Related stories on Pages D6, 7.

TOR
MAY 1 8 1985
Pg 2 of 12



Battelle Pacific Northwest Laboratory

ROCK RESEARCH — Rockwell workers, above, work in the Near Surface Test Facility, a mock repository hollowed from shallow Hanford basalt. Their tests are part of a $354 million study to see if the Hanford basalt would safely contain dangerous radioactive wastes. In the photo below, Kevin M. Cooley, an engineering technician for government contractor Rockwell Hanford Operations, pours some granulated basalt into a container for a yearlong experiment that will test the interaction of rock and heated ground water.

The Oregonian/CLAUDIA J. HOWELL

THE OREGONIAN
Portland, OR
MAY 1 6 1985 Pg 3 of 12

The Hanford gamble: The odds

Ex-employees say Rockwell 'filters' scientific data

Fifth in a series

By RICHARD READ
of The Oregonian staff

Rockwell Hanford Operations, the government contractor evaluating the suitability of the Hanford Nuclear Reservation as a grave for the nation's most dangerous nuclear waste, has dressed up scientific data to make the site look favorable, two former Rockwell employees say.

The former company scientists, as well as some scientists who have reviewed technical work on the U.S. Department of Energy's Basalt Waste Isolation Project, say Rockwell officials have a longstanding practice of playing up supportive data while de-emphasizing negative findings.

"The data is filtered to show the side of the story that they want shown," said Douglas W. Duncan, a former Rockwell advanced geologist who is now an Exxon Corp. senior geophysicist in Denver.

"Most managers want the site to be there," said Duncan, who left Hanford in September 1982 frustrated by the bureaucracy after six months on the project. "The managers seem to be much more apologists than the scientific and technical staff."

Duncan and Michael P. Cochran, a former Rockwell advanced geologist who left after four years also voluntarily to become an Exxon seismic interpreter in 1983, generally praised the scientific work of their one-time colleagues. But they criticized the process that occurs when, as parent corporation Rockwell International's motto puts it, "science gets down to business."

Lawrence R. Fitch, research and licensing manager of the waste isolation project, defended the company's work and rebutted the former employees' views.

"I think it stinks," Fitch said of the two men's statements. Fitch said data were not filtered.

"I've been here six years, and I've never seen that happen," said Fitch, a six-year project worker.

Scientists from various agencies and organizations have criticized roundly two key Energy Department documents evaluating the site, however. The critics use words such as "optimistic" and "misleading" in describing the 1982 Site Characterization Report and the 1984 Draft Environmental Assessment, both prepared by Rockwell.

"You hire Rockwell to conduct this feasibility study, but at the same time the results will impact very heavily on the future careers of the people in the program," Cochran said.

Rockwell will receive a $309 million exploration and research contract if Hanford is chosen, as expected, in August for detailed site characterization.

While the scientists have often been portrayed as biased individuals seeking to advance the site to win more money for Rockwell, they respond that the company is only collecting information impartially so that others may make decisions.

Raymond Lasmanis, Washington state geologist and manager of the state Division of Geology and Earth Resources who has followed the research in detail, said isolation project geologists were well-qualified. But Lasmanis said editors, peer reviewers and upper Rockwell management were responsible for optimism in the most recent draft assessment, which was based on research conducted by Cochran, Duncan and other members of a team of more than 200 scientists and engineers.

"When the basic work gets edited and reviewed and contradictory evidence or controversial reports are downplayed or not mentioned, that concerns me," Lasmanis said.

"I think it's a tremendous problem for the general public not only to wade through the various reports but also to follow up and get copies of the backup information," he said.

Duncan said his conclusions on geologic stability and earthquake frequency appeared with "a different slant" in the December draft assessment. Even a few Rockwell researchers thought their paychecks were more important than the project's integrity, Cochran and Duncan said.

Pressures of the project have caused low morale among the scientists, a problem that persists to this day, according to contacts maintained by Duncan and another scientist who collaborates with Rockwell but asked to remain anonymous.

Rockwell scientists declined to be interviewed independently on the situation in the labs. Company policy requires contacts be made through public relations officers when employees are at work.

Scientists were forced to rehash old data for new reports at the expense of conducting original research, Cochran and Duncan said. Although scientists at times had to "sneak out" on weekends or vacations to do field work, Rockwell managers never made them change basic data, Duncan said.

"I'm talking about something much more subtle and subconscious, a basic belief in the suitability of the site," he said. Cochran said the complexity of Hanford basalt layers stretched the limits of scientific understanding, and Duncan said, "It's crazy to think about putting a repository there."

Rockwell's Fitch said nothing has been identified that would prevent siting a safe repository at Hanford. He denied morale was low.

Fitch and Sue M. Price, Rockwell geosciences group manager, said the company was having no trouble dramatically expanding its staff of top-notch scientists on the project.

Federal officials in other agencies who have criticized Rockwell reports for "non-conservatism" declined to speculate on the cause of optimism but said the situation might have improved somewhat. Leo H. Leonhart, a six-year Rockwell veteran who left voluntarily to become a University of Arizona hydrology professor in March, also said in an interview that he would rather not comment on research fairness.

"I think it's striving toward objectivity," said Leonhart, adding in a subsequent letter that "In the past two years, I have seen a definite turnaround, and I am now convinced that the Rockwell management is striving toward objectivity."

NEXT: Transportation of fuel rods.

TOR

MAY 16 1985

Pg 4 of 12

Ground-water flow carries problems

By RICHARD READ
of The Oregonian staff

A few hundred feet into the side of Hanford's Gable Mountain, visitors sporting hard hats recently encountered a swath of water soaking the gravel floor of the nuclear reservation's mock repository.

"That water you see marks the area between basalt flows," said David H. Underwood, an engineer with the Near Surface Test Facility, a cavern mined from 12 million-year-old Hanford basalt to test possibilities of isolating spent nuclear fuel.

To Underwood, a 36-year Hanford worker accustomed to the gray walls of the 3,330 feet of shallow tunnels, the water at the intersection of ancient lava flows was commonplace. But to hydrologists seeking to understand the ways highly radioactive waste might leach from a repository in volcanic flows 3,200 feet underground, the water is a splitting headache.

In fact, most experts believe it will be ground water that makes or breaks the Hanford repository site. Even the U.S. Department of Energy ranked Hanford a distant last among five candidate sites solely on the criterion of geohydrology, noting water flow within the region's 70 layers of volcanic and sedimentary rock is not well understood.

"Only the Hanford site seems to have the potential for substantial ground-water flows past the emplaced radioactive wastes," the U.S. Environmental Protection Agency said in a recent critique. "The Energy Department oversimplifies the complexities and uncertainties about ground-water flow."

Either Hanford's underpinnings resemble a hot layer cake, in which scalding water flows like runny icing in aquifers between layers of basalt. Or the subterranean environment more closely resembles a gigantic sponge, with high-pressure water infiltrating faults, fractures, loose rock and vertical seams throughout the system.

Rockwell scientists prefer the taste of the layer cake to the sponge, although they say that all the rock below about 160 feet is saturated. Harry W. Brandt, company manager of facilities construction, estimated that 75,000 gallons of water would rush into the bottom of an unlined shaft each minute.

Rockwell scientists maintain that while no one can be sure before going down to take a look, computer modeling indicates vertical movement of contaminated water would not be a significant factor in the Cohassett basalt layer.

Others aren't so sure.

"Virtually all of the Energy Department's assertions relating to the suitability of the Hanford site are based on the primary assumption that ground-water flows occur almost exclusively in the flow tops and interbeds, traveling laterally rather than vertically or radially," wrote consulting geologist Roger Redfern in a recent critique by Forelaws on Board, the Oregon environmental group.

For years, scientists have told Basalt Waste Isolation Project officials they were remiss in failing to explore the possibility for movement of water vertically through basalt. If water moved up or down within layers — perhaps along seams between six-sided columns that form when basalt cools — it could quickly reach aquifers between layers that could carry radioactive waste away, the critics have said.

In June 1982, R. Allan Freeze, a Canadian hydrological expert, resigned from a Hanford peer review committee in dismay, noting the committee's concerns — which included the possibility for large-scale vertical leakage — remained largely unaddressed.

Five months later, the Energy Department maintained in its major Site Characterization Report that vertical leakage was "considered quite low compared to the volume of ground water moving laterally." But in a searing critique, U.S. Geological Survey scientists held that interpretation "subject to question," and again urged borehole testing, which they admitted might not even settle the vexing issue.

In the latest round of critiques, institutions from the Washington Public Interest Research Group to the Yakima Indian Nation to the U.S. Nuclear Regulatory Commission castigated Rockwell and the Energy Department for continuing to view the ground-water configuration optimistically.

"It is a very poor move to be optimistic about it now," said William A. Brewer, Washington Nuclear Waste Board technical director.

Rockwell Hanford Operations scientists denied any optimism, saying they had presented a range of uncertainty reflecting preliminary calculations and one inconclusive test in the Rocky Coulee basalt flow.

Ironically, some critics fault Rockwell for having too little information while others complain so much expensive research has been done already that selection of the site has become a foregone conclusion, the scientists said. Expensive, large-scale pump tests scheduled in six months should provide more answers, they said, adding that measures for preventing pollution of surface water by fluoride, sodium and dissolved solids in ground water to be liberated during the tests were still being devised.

"It's obviously critical as to whether the stuff's going to go straight up, where it only has a short distance to go, or if it will go out laterally, in which case it has a longer distance to go before reaching the accessible environment," said Robert J. Wright, an NRC geologist who is senior technical adviser to the commission's repository projects branch chief.

The "accessible environment" is defined as ground or water beyond six miles from the repository. Rockwell says a median of estimates ranging from 100 years to 1 million years predicts ground water would take 81,000 years to travel that distance.

Contaminants in the water would move slower than that, say Rockwell scientists, who maintain their estimates are conservative in part because they do not take credit for the time water would take to move to the top of a basalt layer.

But the U.S. Department of the Interior said that "available data are insufficient to conclude much of anything."

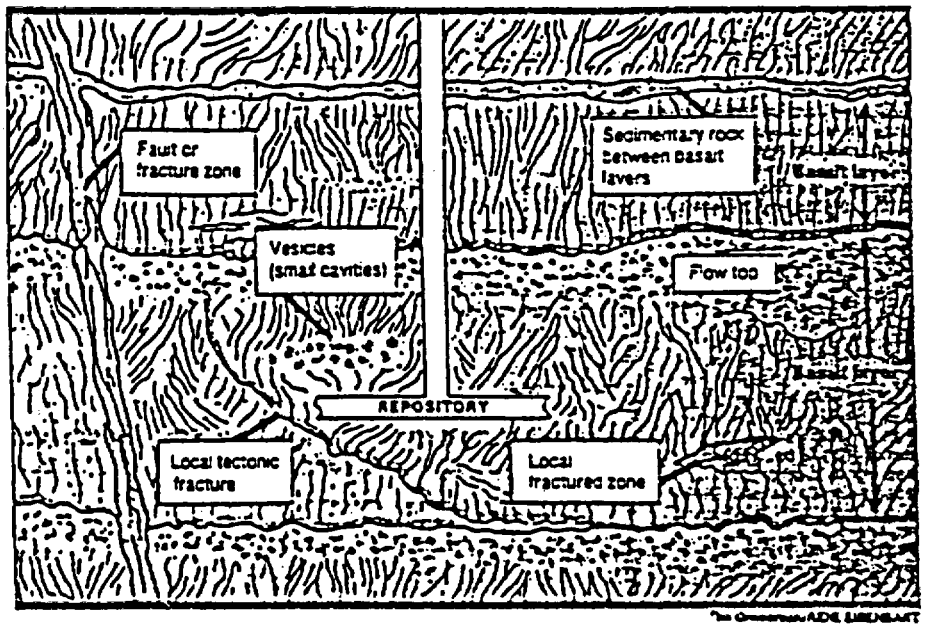
Confusing the game still further, the EPA may change the rules to define the accessible environment as anything beyond 1.2 miles from a repository. The agency's current fifth working draft of radioactive waste disposal standards would require a "reasonable expectation" that certain concentrations of radioactive substances won't show up beyond the shrunken controlled area in less than 10,000 years.

"The old six-mile standard means that a place like Hanford, which is leaky as a sieve, under some scenarios might be acceptable as a repository," said Don Hancock, director of the Southwest Research and Information Center, an Albuquerque, N.M., en-

THE OREGONIAN
Portland, OR
MAY 1 8 1985

Where ground water can go

Various irregularities in basalt affect how quickly water moves through the rock. In addition, scientists disagree on how quickly water contaminated by repository leaks would move upward to the "flow top" of the basalt layer. Because the flow top contains rock pieces and small cavities, water moves more quickly through it than through the dense interior of the basalt layer.



The Oregonian/ADE BRENNAN

vironment and health research and advocacy organization. "It's my speculation that the draft is an EPA attempt to knock Hanford out of the running through their standards."

Daniel J. Egan, EPA high-level waste project standards leader, denied this but agreed that of all the sites, Hanford would be most threatened by the new standards, which are expected to be released in August. Rockwell has not yet analyzed the probability of the site meeting the more stringent requirement, said Richard T. Wilde, company project integration and performance assessment manager.

The EPA, which has hazarded its own estimates of flow times shorter than those predicted by the Energy Department, claims the waste's heat would speed water migration "substantially, perhaps by several orders of magnitude," but Rockwell scientists say the heat effect would last less than the lifetime of waste containers.

Even if ground water is found to move primarily laterally, experts dispute the flow direction. Rockwell and Energy Department officials say that "overall, the ground water appears to flow southeast," resulting in at least a 20-mile path to the Columbia River.

Irrigation near Hanford also will change ground-water flow, contrary to Rockwell assertions that deep water is immediately unsuitable for use, according to consultants for the state of Washington. A recent report by Envirosphere Co. and two other companies said full evaluation of the site would require a model of ground-water flow in an area much larger than the surrounding Pasco Basin.

Steven M. Baker, manager of Rockwell's site analysis group, agreed irrigation would affect flow. A regional ground-water flow study has been conducted in cooperation with the U.S. Geological Survey, but that agency has not allowed Rockwell to release results pending review by other scientists, Baker said.

Future climatic change is yet another uncertainty affecting ground-water flow. Catastrophic flooding resulting from past glaciation has deposited material in the area instead of causing erosion of a kind that could threaten a repository if floods recurred, Rockwell scientists said.

The scientists, who also have analyzed effects of potential dam breaches, remain confident the site's plumbing can be understood.

"Without a considerable degree of certainty about the parameters of these systems, a site can't be built," Oregon state officials said in their recent critique, however.

TOR
MAY 1 6 1985
Pg 6 of 12

Yucca Mountain, Nevada

The Hanford Nuclear Reservation is only one of three top potential sites for a spent-fuel repository — and, like Hanford, the other two are plagued by scientific controversy.

Despite the controversies, the U.S. Department of Energy tentatively nominated the Hanford, Yucca Mountain in Nevada and Deaf Smith County, Texas, sites in December for detailed exploration and research. Final choices are to be announced in August.

In Nevada, the U.S. Department of Energy is evaluating solidified volcanic ash layers, known as tuff, on the southwest corner of its Nevada Test Site, about 100 miles northwest of Las Vegas. The tuff is touted by the Energy Department as a water-free environment that probably contains minerals called zeolites, which it says could latch onto moving contaminants. In addition, the dry environment would retard corrosion of the spent-fuel canisters, the department says.

The government has studied rock mechanics more than a mile into the mountain in an old weapons-testing cavern called G-Tunnel. Canisters of spent fuel were removed from a Nuclear Rocket Development Program radioactive materials handling installation at Jackass Flats and placed in rock as a dry run.

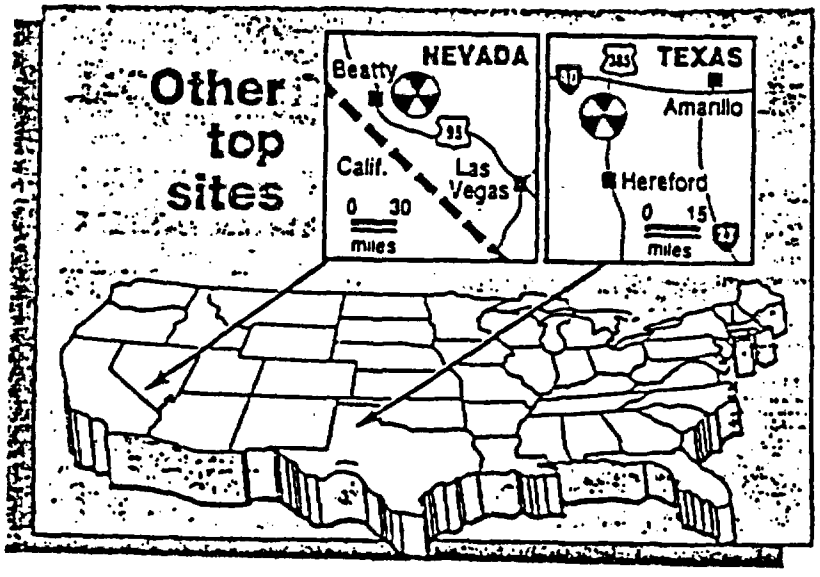
Yucca Mountain would contain a repository at a depth of about 1,200 feet, a separation that would protect the water table 400 feet below, the department says.

"However, the tuff rock is highly fractured," said Carl A. Johnson, Nevada Nuclear Waste Office chief of technical programs. "There is a distinct possibility that water could move along these fractures. If it does, it could move at extremely fast rates, on the order of hours or days instead of years."

The U.S. Nuclear Regulatory Commission also has said that the Energy Department researchers have "made the unsupported assumption" that the site is not subject to faulting, or movement of the Earth's crust.

Both Nevada and the NRC noted heat from the spent fuel could cause zeolites to change into minerals less likely to hinder movement of radioactive materials. The NRC cited a study predicting a potential 40 percent increase in rainfall eventually, and Johnson said climatic changes could raise the water table 400 feet, "drowning" the repository and spreading radioactive materials.

The proximity of the area to the Nevada Test Site, where between 15 and 20 announced nuclear weapons tests are conducted underground each year, compounds concern over seismicity, said Johnson, a geologist. The Energy Department says workers would have to leave the repository during tests, but it says the detonations will pose no problem.



Granite

In addition to the specific sites under consideration in basalt, tuff and salt, the U.S. Department of Energy is beginning to examine granite as the site of a second spent-fuel repository.

The hard, igneous rock has promise, said Brian J. Quirke, an Energy Department public affairs officer in Chicago, where the agency's Crystalline Repository Project Office was established in 1982. Battelle Memorial Institute is the chief contractor on the project.

In general, granite seems seismically stable, devoid of attractive natural resources, resistant to groundwater flow and extremely dense, Quirke said. The rock's density, while favorable for waste isolation, would complicate mining, he added.

The Energy Department has identified 236 rock bodies in Minnesota, Wisconsin and Michigan and in the 14 Atlantic states from Georgia to Maine. In the next few months, those sites will be narrowed to 15 or 20 candidate formations for detailed field study.

Deaf Smith County, Texas

THE OREGONIAN
Portland, OR
MAY 16 1985

U.S. Department of Energy officials like the bedded rock salt of Deaf Smith County, Texas, because they say liquid can't flow through it easily and its ground water flows down.

Salt could dissipate the high heat of spent-fuel rods that would be buried in a repository, and salt could also heal itself if fractured, say the Energy Department officials, who are overseeing Battelle Memorial Institute studies of a 2,500-foot-deep layer formed by evaporation of an ancient inland sea.

Dissolving of the salt layer and corrosion of canisters from watery salt could present problems, but nothing so serious that it would disqualify the site from further consideration, the department says.

But Texas state scientists worry about the 300-foot-deep Ogallala aquifer, which is the primary source of drinking water and irrigation in a region that produces corn, sorghum, wheat and cattle. They worry that there would be irreversible effects if a leaking repository contaminated that underground reservoir and the 800-foot-deep Santa Rosa aquifer.

Steven Frishman, a geologist who directs the Texas Nuclear Waste Programs Office, said Energy Department employees failed to use data on the Santa Rosa provided by his office and then were reluctant to let him use federal grant money to study the aquifer.

"They gloss over uncertainties," Frishman said. The possibility of salt dissolution, which could indicate the presence of ground water and eventually change repository conditions, also is given short shrift, he said.

The Energy Department has failed to consider relatively short groundwater flow paths leading out of the repository site — which could carry radioactivity leaks to the accessible environment — and fractures and faults have been overlooked, the U.S. Nuclear Regulatory Commission said.

At Rippling River Resort in Welches last September, geochemists attending a landmark Geological Society of America Penrose conference on nuclear waste agitated for a vote against the longstanding scientific maxim that salt formations are a good medium for disposing of spent fuel.

David G. Coles, a Battelle Pacific Northwest Laboratory geochemist and a conference coordinator, confirmed that meeting managers quashed the move, fearing it would politicize the strictly confidential tradition of the society's gatherings.

John R. Holloway, an Arizona State University geochemistry professor, said that he suggested the vote among about 70 geochemists partly in jest but said that he meant to prove a point as well. Salt formations are easily reshaped by geologic stresses, and salt flows easily when wet, he said.

TOR

MAY 16 1985

Pg 8 of 12

The Hanford gamble: The odds

Technical controversies surround repository plans

By RICHARD READ
of The Oregonian staff

As the streets filled with snow on a Friday evening last December, a group of workers hastened to leave their desks at the Hanford Nuclear Reservation.

They readied to gather at the Gas Light Restaurant & Bar south of the nuclear complex in downtown Richland, Wash. Food would be "on the company," someone said, and there would be much to celebrate.

The company was Rockwell Hanford Operations. The merrymakers worked for the Basalt Waste Isolation Project, a U.S. Department of Energy effort to study the proposal to place the nation's most dangerous nuclear waste at Hanford. The celebration came after the release of an Energy Department draft environmental assessment naming Hanford among the top three of nine sites being considered in the nationwide search for a nuclear grave.

Since their research began almost a decade ago, Rockwell scientists have probed a plot near the middle of Hanford that some now describe as the most studied chunk of real estate on Earth. While they agree that "tremendous uncertainties" in current data would prevent licensing a spent-fuel repository there now, the Rockwell scientists say that's all the more reason to proceed with further research.

"The more we find, the more favorable the site looks right now," said Steven M. Baker, Rockwell site analysis group manager for the company, which wrote much of the Hanford draft assessment.

Many of the 1,200 agencies, groups and individuals who responded to the assessment felt otherwise, however. Some feel the uncertainties should have disqualified the site long ago.

"I am of the opinion that it's the worst one of all the sites the Energy Department has identified," said Raymond Lasmanis, Washington state geologist and manager of the state's Division of Geology and Earth Resources, in an interview.

Concern centers on the proximity of the proposed repository to the Columbia River, and the possibility that it could be polluted by leaking waste.

The stretch of the Columbia flowing 22,000 lateral feet north of the proposed repository site has been suggested for designation under the federal Wild and Scenic Rivers Act. As the final free-flowing portion of the river in America, the Hanford reach is the mainstem Columbia's last natural spawning ground for chinook salmon, according to the Washington Department of Fisheries.

No one really knows what would happen to the Columbia if waste met rock at Hanford.

The spent fuel to be disposed is intensely hot and contains at least 58 radioactive substances, which in turn will decay into dozens more "daughter" products. Those substances would react in undetermined ways with fuel cladding, waste canisters, packing material, basalt, varying natural heat, clay, ground water, chemicals, seismic movement, floods and additional unforeseen conditions and events over the eons.

Rockwell officials are now hard at work on the final version of the environmental assessment, which is expected this fall. If the preliminary rankings stand, Hanford will be recommended for a $309 million drilling and exploration job, to be conducted by Rockwell and its subcontractors. The total cost of the final site characterization study is expected to be $870 million.

A review by The Oregonian of the draft report and of more than 30 major responses to it identified the main technical controversies surrounding the project. The responses reviewed included those of the U.S. Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, the U.S. Department of the Interior, the three neighboring Indian tribes, the states of Washington and Oregon, the Sierra Club and a variety of individuals.

Rockwell officials initially declined to respond to the criticism, saying to do so in a newspaper interview would be "premature" and "inappropriate." But later they agreed to defend their findings and conclusions in the course of a daylong interview.

Although the subject is divided into separate topics here, the complexity of the issue is ultimately due to the elaborate interrelations among all the scientific disciplines involved. Research quality, site ranking, geochemistry, natural resources and the matter of transporting wastes to Hanford will be addressed as "The Hanford gamble" continues Friday.

THE OREGONIAN
Portland, OR
MAY 16 1985

Tectonics

When Douglas W. Duncan helped write a research report on geologic stability of the proposed Hanford repository site in 1982, the Rockwell geophysicist reviewed data he felt could be interpreted either optimistically or pessimistically.

"I tried to take a middle course," said Duncan, who now works for Exxon Corp. "But looking in the environmental assessment, I saw there was a different slant to it. The general conclusions were stated, but not with the caveats."

Rockwell officials defended their presentation of seismic data in the December assessment. But several agencies responding to the report found problems with earthquake-related conclusions and with the statement that "tectonically active faults do not appear to be present."

The U.S. Nuclear Regulatory Commission said a fault zone called the Rattlesnake Wallula Alignment less than a mile from the site was "omitted from consideration," even though it has been deemed capable of an earthquake of 6.5 on the Richter scale. (The 1983 earthquake that destroyed major sections of Coalinga, Calif., and injured 25 people had an equivalent magnitude.)

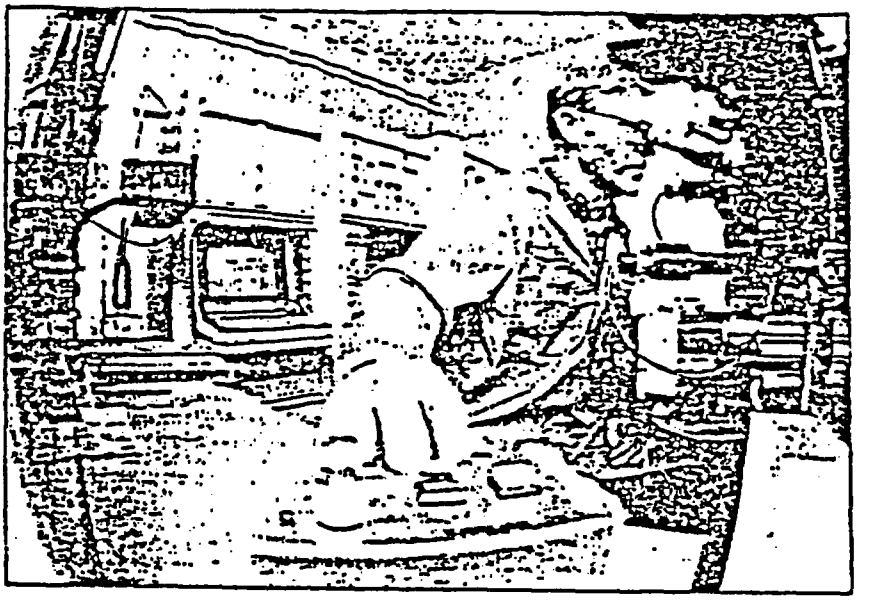
"Given the length of the feature, it is considered capable of generating a major earthquake, potentially involving substantial fault rupture and shaking," the NRC said. The results would include falling rock from the roofs and sides of tunnels, local ground shifts and disturbance of the clay filling in existing rock fractures, the NRC said.

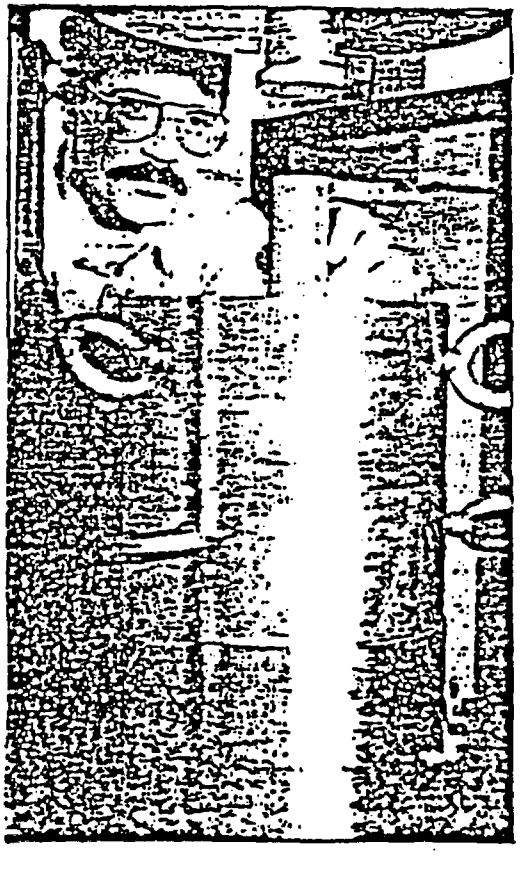
A U.S. Department of Energy statement that a large earthquake would not affect waste isolation is "unsupported," the commission said. And hundreds of microearthquakes — including 10 with epicenters within the repository site — apparently have occurred recently, the NRC said.

"Microearthquake swarms in the immediate vicinity of the underground facility could have adverse impacts," the NRC said. "For example, the larger events in a swarm could initiate rock bursts which could lead to collapse of openings and difficulties in waste emplacement or retrieval operations. Additionally, joints might open and joint fillings could be disturbed which could increase ground-water flow."

Some scientists believe small surface earthquakes could be magnified deep underground, the Environmental Protection Agency and NRC said. The Department of the Interior added that the region's centurylong historic seismic record, followed by 14 years of monitoring, was "a very short period of time indeed for judging expected future seismic patterns."

Rockwell scientists agreed the seismic record was short. But Joe A. Caggiano, a Rockwell geologist, defended preliminary findings and said the Rattlesnake Wallula Alignment had been considered, as well as another zone nearby.





In the lab

Much of the research on the Hanford repository is conducted in Rockwell Hanford Operations' "2101M Laboratory." Above, M. Bruce Stroop Jr. operates an electron microscope in the highly sophisticated lab. John Brocer, senior engineer, at left, places core sample of basalt into rock crusher. After crushing, properties of the basalt are analyzed, below.

Photos by CLAUDIA J. HOWELL
The Oregonian

TOR

MAY 16 1986

Pg 10 of 12

"It's not a fair statement to say we ignored them in our considerations," Caggiano said. Rockwell scientists doubt that the Rattlesnake Wallula is a continuous structure, and even if it is, projections of potential earthquakes are suspect because they are based on data collected in geologically incomparable areas, he said.

Duncan said that he and other scientists felt measurements of seismic movement at the site stretched their equipment's monitoring ability, making long-term extrapolation dubious. In the draft assessment and in subsequent interviews, Rockwell scientists acknowledged the data were "barely beyond the limits of error of the instruments" but concluded no known seismic information ruled out siting a repository at Hanford pending further studies.

The Washington Nuclear Waste Board pointed to discovered anomalies that could turn out to be faults and said recent faulting has been noted nearby. Continuing geologic compression of the area can be expected to produce more faulting, contrary to Rockwell assertions, the NRC said.

The Energy Department reasoned that seismic conditions must be favorable, or the Hanford nuclear plants wouldn't be allowed to operate and the NRC wouldn't have licensed Washington Public Power Supply System Plant 2 at Hanford recently. The Nez Perce Indians called that "back-door logic," however, and NRC staff members said conditions assuring safety of a plant with a lifetime expectancy of 50 years or so were hardly equivalent to those necessary for a repository, which would contain some waste that will be significantly radioactive for hundreds of thousands of years.

"We used the data that was available, and in this case it happened to be for nuclear power plants," said Karl R. Fecht, a Rockwell geologist.

Rockwell said in 1982 that no faults had been identified that would have an adverse impact on a repository, and Energy Department officials dismissed the threat of deformation. But the NRC maintains now, as it did in a critique two years ago, that tectonic stability should be re-evaluated.

The fundamental theory geologists will use to forecast seismic activity at Hanford for 10,000 to 100,000 years has only recently gained wide acceptance. The unifying theory of plate tectonics, which revolutionized the field of geology by declaring that huge, mobile plates make up the Earth's crust, is itself only 20 years old.

Waste package

Rockwell senior scientist Carl C. Allen peered into an electron microscope in a Hanford lab recently, examining bentonite clay at 50,000 times natural size.

If a repository were built at Hanford, the U.S. Department of Energy would hope to use that clay, along with crushed basalt, to surround carbon steel containers filled with spent fuel. The U.S. Nuclear Regulatory Commission requires that the "waste package" material be able to contain radioactive substances for at least 300 years and says releases thereafter must occur within federal limits.

A probability-based analysis relied upon by the Energy Department predicts the steel waste canisters themselves would last about 6,100 years before corroding. Department officials find nothing to contradict a conclusion that waste package specifications could be exceeded at Hanford.

However the NRC, which urged the mathematical analysis in the first place, felt the methodology used was "greatly simplified." Effects of flawed or pitted containers, high temperatures, earthquakes, packing instability and future human intrusion were left out of calculations, the commission said.

Optimism about the waste package was similar to that of the Energy Department prediction that ground water would take 81,000 years to travel out of a Hanford repository, said Robert J. Wright, an NRC geologist who is senior technical adviser to the commission's repository projects branch chief.

"If the ground water couldn't get out in 81,000 years, you could just put the waste in a paper bag down there," he said.

Michael J. Smith, Rockwell engineered barriers manager, agreed that current predictions of canister life were based on limited data, but he said computer models and experiments showed the factors raised by the NRC were irrelevant.

In her written comments, Barbara A. Finamore, lawyer for the Natural Resources Defense Council, criticized the Energy Department for failing to predict the performance of a waste package containing highly radioactive material other than spent nuclear fuel. Experimental work on the question has just begun on expected radiation release from high-level waste bound up in glass or ceramics, said Tris B. McCall, Rockwell engineered barriers design development and analysis manager.

Others are upset by the carbon steel Rockwell has chosen tentatively over more expensive materials to contain spent-fuel rods. The choice was made to save money but the waste package would still exceed requirements, McCall said.

THE OREGONIAN
Portland, OR
MAY 18 1985

Basalt

Rockwell Hanford Operations workers have used a jack to inflict forces of millions of pounds per square inch on a large block of stone chiseled from a wall of Hanford's simulated repository.

They have heated rock in an adjoining tunnel in the Pomona basalt flow to more than 1,200 degrees Fahrenheit.

They have subjected cores removed from deeper volcanic flows to grueling compression tests in nearby laboratories that resemble rock torture chambers.

From these tests and more, the U.S. Department of Energy has reached the preliminary conclusion that the 3,200-foot-deep basalt in the Cohassett flow could withstand the combined heat and stress expected in a repository.

Both the U.S. Nuclear Regulatory Commission and the U.S. Geological Survey, however, think Rockwell scientists have not accounted sufficiently for the effects of the waste's heat on the rock, which is shot through with tiny cracks. Many of the fractures are filled with clay, but the U.S. Environmental Protection Agency worries that possible dehydration and shrinkage effects are being "ignored," an observation denied by Rockwell.

Existing, interconnected rock fractures, and others that would be created by construction, could encourage the upward movement of water contaminated by radioactive substances, the U.S. Department of the Interior said.

In fact, the Energy Department presented information on rock permeability in December that had been "severely questioned" already by the U.S. Geological Survey in 1982, the interior comment noted. Linda L. Lehman, a former NRC scientist who is now a consulting hydrogeologist for the Yakima Indian Nation, said that in one case, based on expert opinion, Rockwell scientists "overrode their own data" on porosity.

"We never override field data," said Roy E. Gephart, a Rockwell hydrologist, who said a panel of experts relied on data in deliberations. While Rockwell scientists said additional experiments confirmed the twice-presented data, the Yakimas said the rock structure alone should condemn the site.

"The site is so geologically complex that enormous amounts of money would have to be spent in what would nonetheless probably be a failing attempt to characterize it with reasonable assurance," the tribe's critique said.

Even if the naturally stressed rock were found to be strong enough, the Cohassett layer might not be sufficiently thick and broad to provide the required 2,000 acres through which horizontal tunnels would run, said Raymond Lasmanis, Washington state geologist and manager of the state Division of Geology and Earth Resources.

"The basalt beds are not as thick as originally envisioned," said Lasmanis, a 21-year mining industry veteran. "I have some real concerns about that."

Indeed, a recent unexpected finding caused Rockwell to switch preference abruptly to the Cohassett from a deeper layer called the Umtanum flow. The Umtanum was favored until surprised borehole drillers encountered loose rock that cut estimates of that layer's dense interior by a third — to 83 feet, a width only 13 feet thicker than the minimum believed necessary to hold repository.

Both layers are formations of the Grande Ronde Basalt, a group of lava flows between 15.6 million and 17 million years old. The Grande Ronde is the largest of five formations in the 16,000-foot-deep Columbia River Basalt Group, and one of its tentacles reaches past Portland.

Lawrence R. Fitch, Rockwell research and licensing manager, said the Cohassett was chosen because it was shallower, cooler and thus less costly to develop than the Cohassett. Rockwell said the usable dense interior of the Cohassett was amply spacious — roughly 230 feet thick — but the NRC said the claim appeared "misleading."

Driving the required 15-foot-diameter holes into the dense basalt would be an unprecedented task, and the Energy Department notes Hanford would be the most expensive and difficult of the top five repository sites to place, build, operate and close.

Dumping

The Umatilla and Nez Perce tribes are troubled by tritium contamination of more than 100 square miles of Hanford ground water, and many Indians feel the spread of the radioactive hydrogen may be an omen of things to come from a repository.

The U.S. Nuclear Regulatory Commission worries that the four decades of waste-water disposal that created the tritium contamination could have altered natural ground-water conditions, affecting scientists' ability to predict a repository's isolation potential.

Numerous respondents to the U.S. Department of Energy's draft environmental assessment concurred with the state of Oregon in the concern that existing Hanford contamination would complicate detection of releases from a repository. And still more reviewers felt the assessment's cursory descriptions of existing Hanford plants and wastes showed Energy Department officials had not considered some troublesome ramifications of locating a repository at a nuclear reservation.

"The defense wastes are as much a part of the physical environment at Hanford as cheatgrass and jack rabbits, yet they were not discussed," said William A. Brewer, Washington Nuclear Waste Board technical director.

In addition, future plants and more waste expected at Hanford were not even mentioned, said Larry Caldwell of the Hanford Oversight Committee, a coalition of Northwest environmental, labor, peace and religious groups. Those plants would be identified in another assessment in 1991 if the site is selected, Rockwell officials said.

Rockwell officials said discharged waste water had no discernible influence on deep basalt, adding that radiation monitoring could be conducted close to the repository to avoid confusion with existing pollution. The Energy Department maintained that nearby activities were expected neither to pose "irreconcilable conflicts" with a repository nor to release radiation sufficient to exceed standards when combined with repository releases.

But the Yakima Indians said accidents at Hanford plants could disrupt repository operations or vice versa.

"We took our raps for that in the environmental assessment," said Ed B. Ash, Rockwell Basalt Waste Isolation Project director.

Several reviewers faulted the Energy Department for failing to consider presence of Hanford's 13,500 workers in describing the complex as remote. The city of Spokane, which is downwind of Hanford, called the analysis of airborne radiation releases from repository operations "inadequate."

The Energy Department also inadequately analyzed radiation that would be emitted when fuel rods were packaged together for burial, said the EPA, which estimated the procedure would emit about 22,500 curies of krypton-85 annually. A curie is a measure of radioactivity, equal to 37 billion disintegrating atoms per second.

TOR

MAY 16 1985

Pg 12 of 12

"How they come up with that, I have no idea," said Lawrence R. Fitch, Rockwell research and licensing manager.

The Umatilla Indians urged an extensive study of region's radiation levels so that effects of any release to the Columbia River or elsewhere could be evaluated.

"The draft environmental assessment does not sufficiently address the potential effects of downstream contamination," the EPA said.

Washington Rep. Dick Nelson, D-Seattle, said an analysis of contamination effects should include cost estimates of potential damage to agriculture, fishing, recreation and drinking water and of evacuations.

"I think I would answer the question the other way around," said Fitch, noting the detailed licensing requirements of the NRC, which would license any repository. "If there is a significant probability that radiation will reach the river, then you do not have an acceptable site, and there will not be a repository built at Hanford."

To Nelson, that logic is fundamentally flawed, because it puts more faith in the laws of the land than in the laws of probability.

"There is a chance the repository will fail," Nelson said. "Even if it's very low, then we should know what the damage would be and choose the site that will do the least amount of damage."

THE OREGONIAN
Portland, OR
MAY 17 1985

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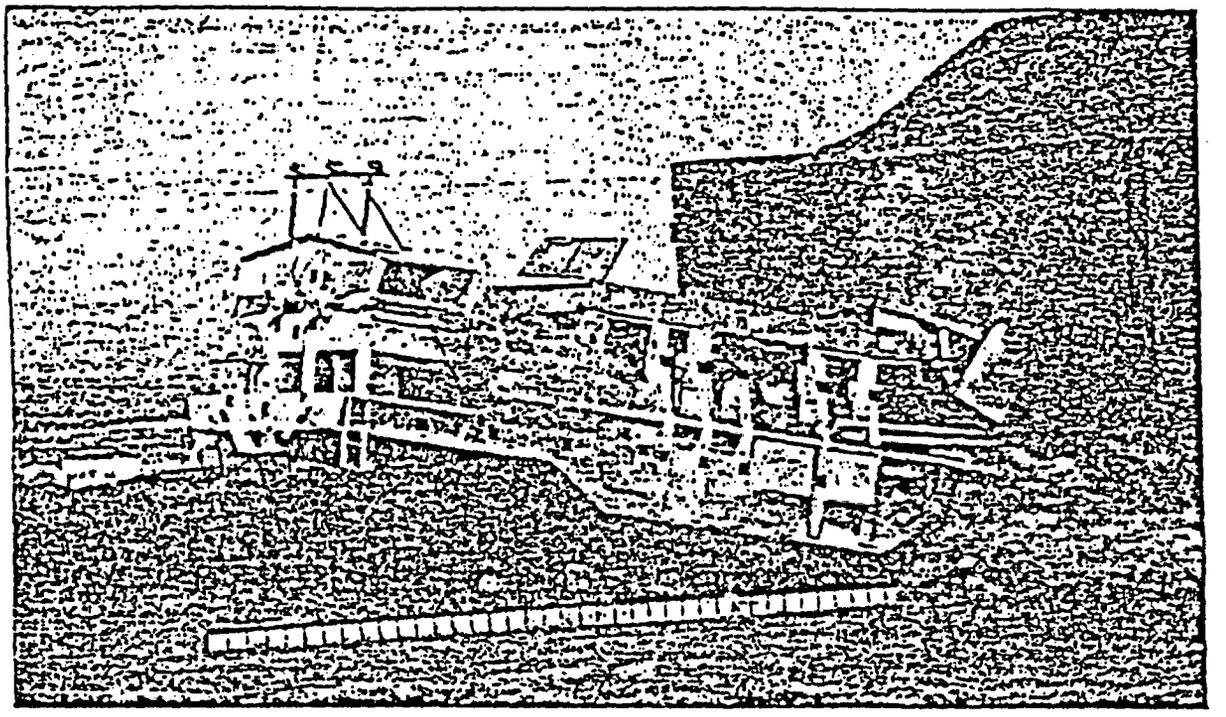
Pg 1 of 9

The Hanford gamble: The odds

Transportation risks raise nuclear traffic concerns



Sandia National Laboratories

TEST CRASH — A railroad car carrying a shipping cask for spent fuel rods is rocketed into a concrete wall, in a test of the cask's strength.

Sixth in a series

By SPENCER HEINZ
of The Oregonian staff

All of the wiggly statistics, fat reports and head-knocking tantrums over transportation of nuclear waste wind down to a fundamental rule of good housekeeping.

When you take out the trash, do not spill it along the way.

Amid the mystique involving things radioactive, America is hunting for a way to get its most long-lived wastes from where they are now to somewhere else.

That could be 30 miles north of Oregon in Washington's Hanford Nuclear Reservation, one of three places nationally with a shot at being America's first permanent nuclear repository.

Key decision-makers believe it is necessary to move thousands of America's spent-fuel assemblies because the present locations of those assemblies — in deep pools of radiation-shielding water at the nation's 88 working commercial plants — provide no permanent protection from substances that remain significantly radioactive for thousands to millions of years.

The resulting problem is unique: Unlike any other domestic landfill issue to confront America in its two-century history, the risks and perceptions of risks are not all confined to people near the actual disposal site.

In fact, while the atomic landfill community receives most of the direct financial benefits from construction of a multibillion-dollar repository, hundreds of communities along the transcontinental pathway are likely to experience only the risks generated by more nuclear traffic.

And Northwest states have a special stake in the process.

Most of the nation's commercial nuclear power plants are in the eastern United States.

The handful of states closest to the Hanford destination would provide the doorstep for a steadily diminishing number of pathways for all of the waste — up to 173,229 tractor-trailer truckloads or 22,465 trainloads of spent-fuel rods over 28 years after 1998, according to the U.S. Department of Energy Draft Environmental Assessment of Hanford's potential as a waste repository.

That means instead of a half-dozen spent-fuel shipments now cutting through Oregon each year, the state annually could see closer to 5,800.

Analysts call it the funnel effect, and the 7.9 million residents of Oregon, Idaho and Washington are at the thinning end.

Taking out the garbage brings an American problem home.

At the Arrowhead Truck Plaza on Interstate 84, just east of Pendleton at the bottom of a tricky downslope known as Cabbage Hill, Brent A. Kohler, a trucker carrying a tankful of cooking oil out of Kaysville, Utah, tries to figure it out.

"If all the nuclear plants are back East," he says, "why don't they keep it back East? It don't make logical sense that they would want to bring it across."

To a much lesser extent, they already do. The Oregon Department of Energy reports that more than 1,700 shipments per year of mostly low-level radioactive materials such as pharmaceuticals and contaminated nuclear

TOR

MAY 17 1985

Pg 2 of 9

equipment already move through Oregon. Fewer than 70 of those shipments normally originate inside Oregon. And of those, only a half-dozen or so carry lethally radioactive fuel rods similar to those that would be shipped by the thousands to a national repository.

The Oregon Department of Energy says 90 percent of all of the radioactive shipments through Oregon come out of Idaho on Interstate 84 and pass through the Oregon cities of Ontario, Baker, La Grande and Pendleton before crossing the Umatilla Bridge for the final 30 miles north to Hanford. Most of the others take Interstate 5. Barging of radioactive materials on the Columbia River has been used infrequently but is among the tranportation options under consideration for a national repository. The safety record is good, but accidents do happen.

Richard M. Huggins, Union County emergency management director in La Grande, said there have been four mishaps in the last four years involving vehicles carrying radioactive materials through Oregon. Trucks tipped over, containers stayed intact, nothing leaked. But of the four accidents, he said, three were within 50 miles of La Grande and of those three, two happened within the wintry twists of I-84's Cabbage Hill and Ladd Canyon.

"Those two passes are known as the worst two passes between Portland and New York," Huggins said. "It's a very difficult area to travel in the wintertime. It's steep and it's windy and it sort of creates its own weather."

Huggins believes it would be wrong for those considering thousands of high-level waste shipments through Oregon to think of all roadways as benignly equal.

"They close the road to mobile homes because it gets icy," Huggins said. "I think they ought to consider doing that with hazardous materials."

Brent Kohler, the cooking oil driver out of Utah, said a ride over Cabbage Hill may be an emotional experience, but for experienced drivers, it is negotiable with its frequent emergency turnout ramps. In contrast, Kohler said, some of the Idaho routes he has traveled were "horrid," narrow and rutted.

"It's about like trying to herd it instead of driving it," he said.

Getting it there safely is important because a multibillion-dollar repository would be just an overbuilt basement without things to put down in it.

That repository dream has required planners first to experience a nightmare:

Nuclear waste in transit is at a point most vulnerable to accidents or terrorist attacks. Critics call it the weak link in the chain of logic that allows any reasonable consideration of a national waste repository.

"A major omission in the draft environmental assessment was the lack of a thorough consideration of route and site-specific transportation risks," William T. Dixon, who is riding herd on Hanford as administrator of the Oregon Department of Energy's Siting and Regulation Division, wrote in Oregon's critique of the U.S. Department of Energy's Draft Environmental Assessment of Hanford.

"We feel that all the risks and costs of transportation must be addressed. These include health effects due to radiation exposure, non-radiological accident risks, costs and impact on public confidence."

Oregon's message was among thousands of pages of critiques and public hearing testimony filed within the last two months by dozens of federal agencies, environmental organizations and affected states and cities.

Among the criticisms:

- The Energy Department cannot wisely evaluate the Northwest impacts of a nuclear repository because the agency has tended to focus too narrowly on the immediate Hanford area alone.

"For example," wrote the Washington Nuclear Waste Board, "a broader region could include areas such as the Columbia Gorge with frequent highway icing, steep grades in Northeast Oregon, and the high elevations of the Intermountain West with their periodic blizzard and snowdrift conditions."

Lake H. Barrett, director of the Division of Transportation and Waste Management with the Energy Department's Office of Civilian Radioactive Waste Management, replied in an interview that follow-up work would focus more on local routes. "We didn't specifically look at everyone's deadman's curve," he said.

- Some routes, the Environmental Protection Agency said, have "high-risk conditions. The Hinkle, Ore., rail classification yard and major steep grades on Interstate 90 to the north, and Interstate 84 to the south, could contribute materially to accidents and delays" and radiation exposures.

- The Energy Department Draft Environmental Assessment may have underestimated radiation doses to people during the cross-country delivery trips. The EPA said better dose calculations could be obtained by figuring that bad weather forces trucks to pull over occasionally for long periods, thereby increasing radiation exposures to bystanders.

(The Energy Department has calculated that a hypothetical person who stood, for the entire 23-year repository receiving period, 100 feet from spent-fuel shipments traveling at 15 mph would receive a total dose of 16 millirems from trucks and only six millirems from rail shipments, compared to the yearly average radiation from natural background sources of about 100 millirems.

(And, from normal traffic accident rates having nothing to do with radiation doses, the Energy Department predicted 77 deaths and 983 injuries if all 173,000 shipments were by truck; and 3.5 deaths and 42 injuries if by train.

(The Energy Department draft assessment said about 70 percent of the shipments would go by train on main lines and the rest by truck on interstate freeways. Critics say the department has not made clear how it could have reached that conclusion before selecting a repository location and considering other variables.)

- The Energy Department is depending too heavily upon states to provide emergency response teams. And the federal Price-Anderson Act limits the government's liability in an accident to $600 million.

"Typically, the Department of Energy goes to great lengths in its promise of safety," Liz Christensen, a member of the Spokane League of Women Voters and the Hanford Education Action League, told Energy Department officials during a public hearing last March in Spokane. The Hanford Education Action League is a Spokane-based citizen watchdog group of physicians and others who believe Hanford is threatening the regional health.

"Yet the federal government will not take the one simple step of accepting unlimited liability in the event of a shipping accident that would show faith in the USDOE's claims of safety."

Replies Barrett: Congress sets the limit and has the power to make exceptions.

- Not enough analysis was done on the effects of transporting spent fuel through downtown Spokane on Interstate 90.

"If spent-fuel rods were to be exposed on I-90 near our hospitals," said Joan N. Mootry, a Spokane member of the Hanford Oversight Committee, "even under moderate meteorological conditions, it is probable that the entire center of downtown Spokane would have to be evacuated immediately and would remain uninhabitable for at least 100 years."

THE OREGONIAN
Portland, OR
MAY 17 1985

Could such outright exposures occur?

In almost no conceivable way, according to controversial reports from the Transportation Technology Center of Sandia National Laboratories, which is a prime contractor to the U.S. Department of Energy at Albuquerque, N.M.

In a series of highly publicized crash tests in 1977 and 1978, Sandia attached rockets to cask-bearing railway cars and truck rigs and sent them high-tailing into a 690-ton block of reinforced concrete.

They also suspended the casks over pools of flaming jet fuel and distributed films of the action nationwide to support the message that high-level waste can be shipped without fear of leakage.

Despite criticisms that the tests may not have shown whether casks actually in use are leakproof in extreme situations, Sandia officials remain confident that their work proves typical casks will completely contain radioactive material during the accidents that can be expected to occur an average of once every 400,000 miles.

Robert M. Jefferson, who was Sandia's Transportation Technology Center manager during the crash tests and until his departure seven weeks ago to become a private consultant, said since the first high-level spent-fuel shipments started in 1964, there have been four accidents with spent-fuel casks. Two of the casks were carrying spent-fuel rods. He said no radioactivity was released.

"You're about 1,000 times more likely to get run over than irradiated," he said.

Beyond simple accidents, there is concern about possible cask attacks and blackmail by saboteurs armed with explosives.

Sandia's first studies of this in 1978 and 1980 produced results that scared people. After presuming a terrorist attack with high-explosives on a spent-fuel shipment in a densely populated city, Sandia calculated, according to a June 8, 1984, report in the Federal Register, that up to 106 pounds of radioactive materials would be released from the cask. Sandia said that would be enough to cause hundreds of early deaths and thousands of cancers years later.

Robert E. Luna, supervisor of the Risk Assessment and Transportation Systems Division at Sandia's Transportation and Technology Center, said those paper calculations were enough to cause the center actually to try to blow casks up. The explosives used had the "capability to penetrate two or more feet of metal, eroding everything in its path," according to the same Federal Register report.

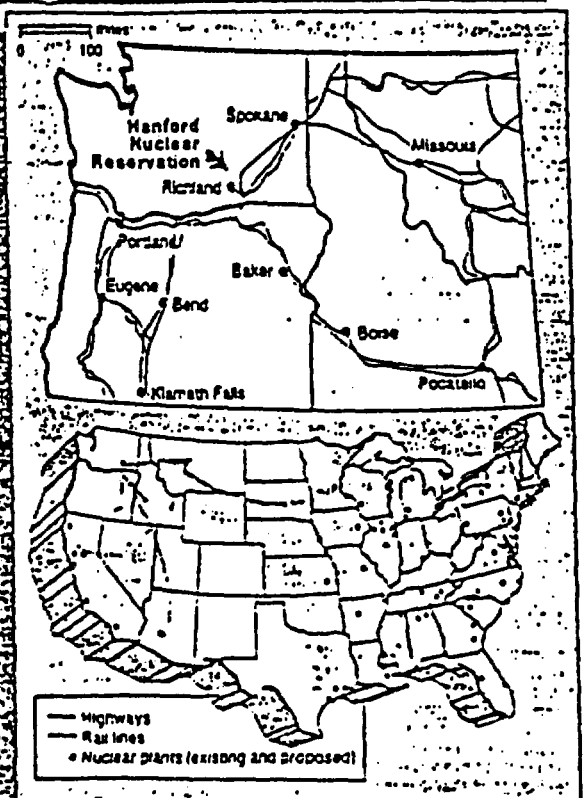
The sabotage attempts released, according to the Federal Register, a maximum of only 9 grams — about one-third of an ounce — of respirable radioactive material. The Energy Department relaxed. In contrast to 106 pounds, the 9 grams of radioactive materials would result in no early deaths and "one to a few" cancer deaths in later years, Luna said.

Jefferson said America now has in use a total of 19 truck and rail spent-fuel casks that weigh anywhere from 25 to 120 tons, and which are designed to carry only about one-eighth of their total weight in spent fuel.

"If you'll give me a 10-kiloton nuclear weapon," he said, "it'll break the thing open, but you know — the cask is going to be the least of my worries."

Second Lt. Lawrence M. McKinley, training officer with the Oregon Army National Guard's 1249th Engineer Battalion, said there were miners, loggers and military people with the expertise to blow apart virtually anything if they have direct access to the target, knowledge of stress points and enough time to drill and implant explosive charges.

Westward to Hanford



If the Hanford Nuclear Reservation were chosen as the nation's first repository for spent nuclear fuel, 77,000 tons of spent fuel would have to be brought there — most of it from nuclear power plants in the East. No routes have been determined, but Department of Energy planners say the interstate highway system and major rail lines would be the likeliest.

But Roy F. Garrison, the Energy Department's chief of Transportation in Washington, D.C., said he believed the system gave little incentive or opportunity for terrorist actions because the Sandia tests showed very little release of radioactivity; because drivers had to report their positions every two to four hours; and because of other precautions kept secret.

"We have a success story now, and we want to keep it that way," he said.

Government hopes are clouding reality, claims Marvin Resnikoff, a Sierra Club staff scientist who spent 1981 to 1983 researching nuclear transportation issues for the non-profit Council on Economic Priorities in New York City.

Resnikoff claimed in an interview that some traffic accidents could exceed cask design standards and that Sandia's attempts to simulate terrorist actions by using military weapons against spent-fuel casks did not consider "commercially available devices that could do a much better job."

Resnikoff said a commercial shaped conical charge, combined with an incendiary pellet, could produce temperatures of up to 3,000 degrees Fahrenheit. The government's minimum cask-testing temperature is 1,475 degrees for 30 minutes.

Earl O. Rutenkroger, nuclear and hazardous materials representative with Tri-State Motor Transit Co. out of Joplin, Mo., said his company — the nation's largest common carrier of radioactive materials with about 6,000 mostly low-level shipments a year — has run about 60 million vehicle miles with "no significant" container damage.

"In my personal opinion, it's probably one of the biggest overkills that exists in highway safety," he said of some nuclear transportation measures.

"It really is very, very safe movement. The only danger really is that someone's going to get mashed by a 50,000-pound container."

As proponents and opponents continue to nurture remarkably contradictory perceptions of risk, states are beefing up emergency response teams with this understanding:

The nuclear industry may have a transportation record that is good, but the extreme public health consequences of a major cask-cracking accident demand something close to perfection.

Everyone agrees that nuclear waste has to go somewhere, but not through their backyards.

TOR
MAY 17 1985
Pg 4 of 9

"People are going to look out for their own self interest," concluded Robert W. Robison, radioactive materials emergency coordinator with the Oregon Department of Energy.

"At the same time," he said, "the overall decision-makers have to look out for the national interest.

"Ourselves, we will look at the risks, and we will see if the risks for Oregon are acceptable."

What will be an acceptable level of risk?

"You've asked the question of the decade," he said.

NEXT: The Columbia River.

Oregon: A pathway to Hanford

Oregon could assume a greater risk of accidents than Washington if the nation's spent-fuel rods were delivered to Hanford by truck, according to the Oregon Department of Energy.

That is because the risk factors include not only numbers of shipments — but also total miles traveled.

And Oregon — even though it does not carry status as an "affected" state eligible for Energy Department money to study repository impacts — would bear the brunt of that nuclear truckload mileage.

If all the fuel rods went by truck, that would bring an annual average of 5,845 spent-fuel shipments through Oregon, compared to about a half-dozen per year now; 5,917 through Idaho; and 6,405 into Washington, according to the U.S. Department of Transportation.

Robert W. Robison, radioactive materials emergency coordinator for the Oregon Department of Energy, noted that, of Washington's projected 6,405 shipments, 5,845 already would have passed through Oregon — about 90 percent (5,260 shipments) of them on the 210-mile segment of Interstate 84 between Ontario and Umatilla.

Most of those same 5,260 shipments, Robison said, would travel only about 30 miles in Washington before arriving at Hanford. In total, those shipments would account for only about 157,000 annual vehicle miles in Washington, compared to about 1.1 million annual miles in Oregon.

Robison said Idaho would carry a truck mileage burden similar to Oregon's, but he emphasized that mileage and numbers of shipments alone are only two of the factors (others include weather conditions and current accident rates) that need to be considered in assessing risks to states.

Richard C. Hannon, policy analyst with the U.S. Department of Transportation's Materials Transportation Bureau, said, if all of the fuel rods went by rail, up to 763 rail shipments per year would pass through Idaho, 830 through Washington and 233 through Oregon. Robison said he knew of no spent-fuel rail shipments passing now through Oregon.

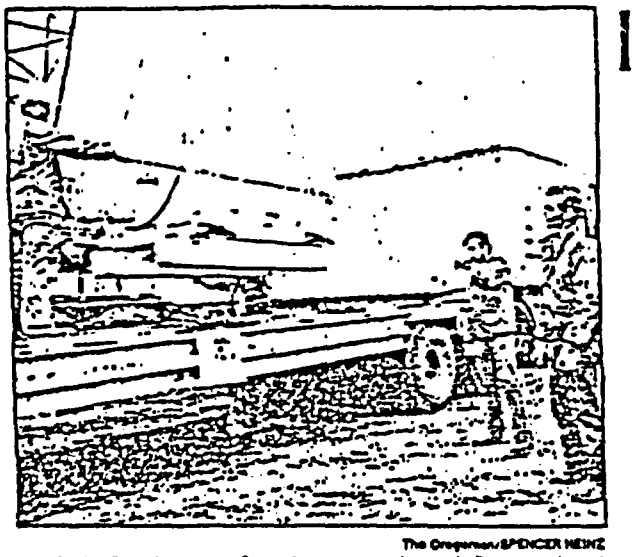
The U.S. Department of Energy — while saying that it intentionally has overestimated the numbers of shipments that it believes actually would be required — predicts one truckload of spent fuel could be arriving at Hanford every 90 minutes during the peak delivery years.

Among the unknowns are how much of a part barge transportation would play and whether the Energy Department is able to open a temporary storage station at the site of the canceled Clinch River breeder reactor project near Oak Ridge, Tenn. Energy Department officials say that could reduce the frequency of shipments to a permanent repository.

THE OREGONIAN
Portland, OR
MAY 17 1985

The Hanford gamble: The odds

Two truckers take care with load of hot stuff in tow



The Oregonian/SPENCER HEINZ

UNLOADING — James H. Stein (center) and Larry J. Bergeron (right) watch unidentified worker guide crane cable lowering 22,000-pound containment cask onto another trailer. Truckers haul plutonium and uranium.

By SPENCER HEINZ
of The Oregonian staff

HANFORD NUCLEAR RESERVATION, Wash. — James H. Stein and Larry J. Bergeron haul the hot stuff for a living.

Hooked 10 feet behind their cab, packed into a 22,000-pound cask the shape of a vitamin B-12 pill, is a 50-pound payload of plutonium and uranium.

Like a spaniel on a leash, the load obediently tracks them through midnight rain and snow.

Bergeron maneuvers their 18-wheel rig along a 615-mile, 12-hour, slush-covered run from the Idaho National Engineering Laboratory in the southeastern corner of Idaho to the Hanford Nuclear Reservation in Southeastern Washington.

Bergeron, 42, and Stein, 35, are a team — one of the few authorized to haul high-level radioactive materials. They work for Tri-State Motor Transit Co., one of a half-dozen companies nationally that haul most of the nation's high-level radioactive materials.

Out of 1,500 drivers nationally, Tri-State has 60 drivers authorized to carry high-level radioactive shipments like the one on its way to Hanford.

For the last two years, these two Pocatello residents have been criss-crossing the United States and Canada with loads of nuclear products under contract with the U.S. Department of Energy and its subcontractors.

They are on a round-trip run, part of the unpublicized monthly movement of experimental radioactive materials between the two government nuclear outposts.

They file secret route schedules. Every four hours, they report their location to nuclear trackers. They carry a telephone, a citizens band radio and a Geiger counter that peeps like a dying sparrow in the presence of radiation.

"This stuff's pretty safe," Stein allows, and he motions to the trailer behind him.

"You know, I wouldn't be afraid to go back there and eat my lunch when I'm hauling that stuff — back in that trailer — to be frankly honest with you."

Aside from small placards on the trailer that say "Radioactive Materials," nothing about their tractor-trailer combination looks unusual.

Likewise, there is nothing about Stein and Bergeron that says they are anything but another couple of truckers at the roadhouse doughnut tray.

"We go into a truckstop and eat or something, and it's like I was telling you — we look just like a couple of truckers, sitting down with these different guys," Stein says. "It's kind of nice to know that you're just a little smarter than the rest of them, that you're not just the average trucker. We have a helluva responsibility with this stuff. You just wouldn't give this to anybody that walked in the door."

They say they have completed a three-week course with periodic update sessions on nuclear packaging and what to do if they were to dump a load. (They would try to limit any leakage, warn others to stay clear and call for emergency response teams.)

"This is more than just a job for us," Stein says. "It's a responsibility."

The two say they never have had an accident — although Stein certainly does wince when he remembers what happened this year while a crane was loading an 8,000-pound cask onto their rig at Schenectady, N.Y.

"They dropped the cask on one of our trailers," he says. "That's the only incident I've had happen in the seven years I've been hauling. The cable on the crane busted."

Considering the mess they could have had on their hands, things turned out fine.

"Never bothered the cask," he says. "Bent the hell out of our trailer."

The truckers pull into Hanford. Federal regulatory agents with clipboards and laborers with Geiger counters and a 75-ton Lima loader crane unchain the vitamin B-12 pill and take it away.

In more than fair exchange, the crane lowers onto their truck a 40,000-pound cask shaped vaguely like a dog bone, loaded with cobalt-58 and cobalt-60, and it is time for another 10 to 12 hours and 615 miles of keeping it on the road.

The responsibility of the job carries its own measure of prestige.

But there are those owl-eyed nights on the road, Stein allows, when rain

is slapping at the windshield and the radio is fuzzing with something out of Utah; when the cask is tracking nicely behind the yellow wedge of his high beams; and when he spirits a few thoughts to his family back in Idaho, to his wife, Kathy, and to his Abby, his Sadie and his Andrew. He hauls nuclear, but he is only human.

"Wished I was home," he says.

TOR
MAY 17 1995
Pg 6 of 9

Ranking

Terry Moore prides himself on knowing a stacked deck when he sees one.

Moore, a policy analyst for the Eugene consulting firm of ECO Northwest, spent two weeks with three other company analysts reviewing the method used by the Energy Department in picking Hanford as a top candidate for extensive repository research.

No overt manipulation of numbers stood out, he said, but basic statistical errors meant the best sites were not necessarily identified.

"It seems to me a pretty poor comment for us to come in and spend two weeks and find that the methods they used don't add up," said Moore, who worked under a state of Washington contract.

In its ranking system, the Energy Department compared individual attributes of five top sites. Scores were then compared using three different techniques that in sum showed the Hanford, Yucca Mountain, Nev., and Deaf Smith County, Texas, sites to rank highest.

Even assuming the Energy Department's scientific appraisal of various site characteristics was correct, scorers double-counted certain features, Moore said. One ranking method that assigned points from one to five to site attributes was flawed because it failed to account for wide margins of preference between individual site characteristics, he said.

"The problem with that is that one simply cannot assume that the top site on a given criterion is five times better than the bottom site," Moore said. "They might have picked the most diverse sites, but there is nothing in their analysis to suggest to us that they have the three best sites."

Ellison S. Burton, Energy Department office of geologic repositories siting division director, agreed the point method had limitations but said methodology mattered less than results.

"You do an analysis in order to gain insight, not to generate a bunch of numbers," Burton said. "The purpose of doing this kind of analysis is to find out which sites tend to appear most often at the top and which at the bottom."

But the National Academy of Sciences board on radioactive waste management said in a letter that the method used was "unsatisfactory, inadequate, undocumented and biased." And the Interior Department complained that the ranking procedure degenerated into a "vote-counting numbers game."

The Energy Department's siting guidelines required that more weight be given to factors surrounding the repository's performance after abandonment than to factors relevant to building and filling the repository. But the Energy Department weighted these considerations "virtually the same," satisfying the letter of the requirement by using a 51 percent to 49 percent split, U.S. Geological Survey officials said.

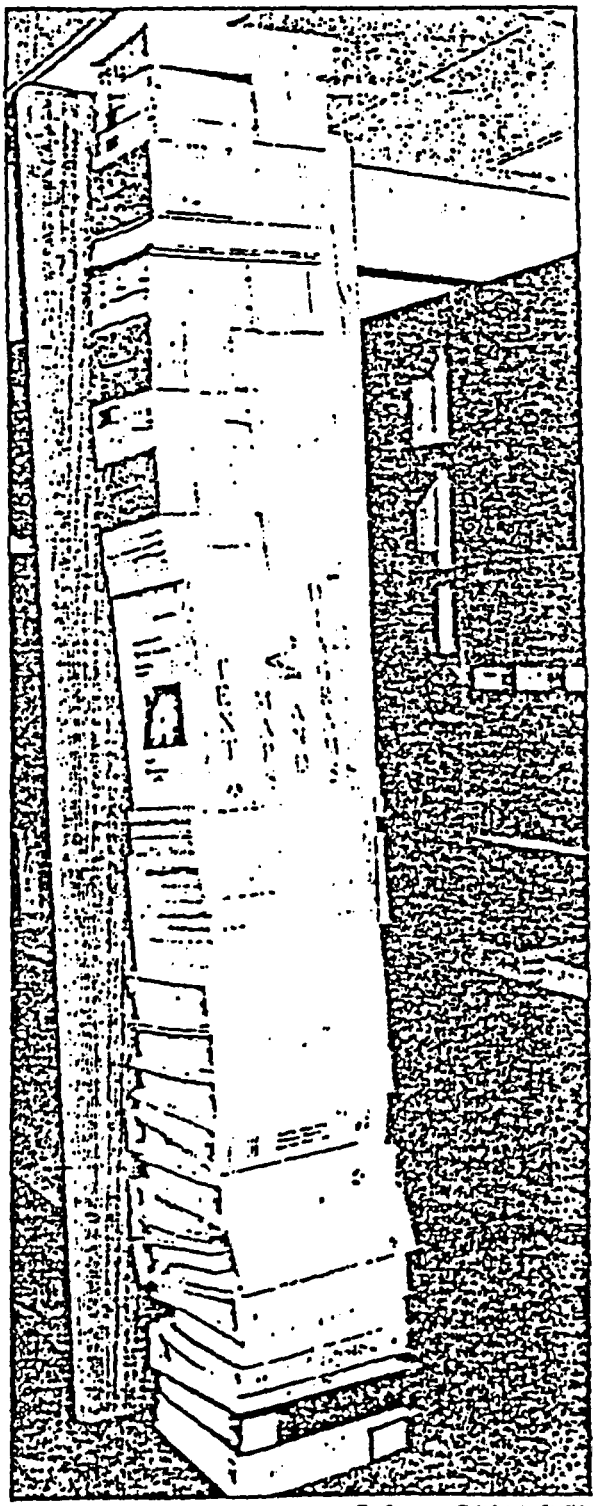
The fact that more was known about immediate performance of repository operations than the long-term performance of the nuclear grave had a similar statistical effect, the NRC said. Factors influencing long-term isolation of waste should be given the greatest import, the EPA said.

Burton responded that trial runs that gave more weight to long-term performance did not change results.

In the final environmental assessment this fall, the Energy Department should "reconsider" its rankings after modifying individual scientific conclusions to reflect criticism, the NRC said. The academy panel advised redoing the ranking with a new panel composed of independent scientists, and suggested recommending five sites for further study in case "one or more sites should fall by the wayside."

Energy officials are considering recommending five sites to the president this fall, and suggestions to redo the rankings also are "under consideration," Burton said.

The possibility remains that the top three sites will change after the Energy Department reviews a total 15,000 comments, he said.



The Oregonian/CLAUDIA J. HOWELL

STACKING UP — Documents above are among scientific reports that have been prepared on proposed repository site at Hanford.

Geochemistry

THE OREGONIAN
Portland, OR
MAY 17 1985

David E. Grandstaff likes to bring up Iceland in conversations about the Hanford repository project.

"Basalt in Iceland is very similar to rock at the Hanford site," said Grandstaff, a geochemistry professor at Temple University, which is a Rockwell subcontractor. "There's hot, geothermal water in Iceland that indicates conditions would be quite reducing."

Geochemical reduction, or oxygen removal, would be favorable in a repository, because ground water lacking oxygen would lose its ability to carry away many radioactive materials. In fact, Rockwell points to reducing conditions as one of Hanford basalt's best aspects for waste containment.

But the U.S. Nuclear Regulatory Commission considers Rockwell's reasoning "insufficient" because the conclusions rest too heavily on theoretical data.

"They're a little less inclined to point to some of their own laboratory work, which suggests the waters aren't reducing," said Robert J. Wright, an NRC geologist who is senior technical adviser to the commission's repository branch chief.

Mark I. Wood, a Rockwell geochemist, said scientists have found one mineral at the site that could exist only in reducing conditions. Misunderstandings on the part of NRC officials could be expected, because commission reviewers have no "hands-on" experience with Hanford repository research, said Lawrence R. Fitch, company research and licensing manager.

Geochemist Grandstaff, who acknowledges prediction of chemical reactions thousands of years hence is difficult, has mixed simulated radioactive waste with basalt and ground water. He has found radioactive substances including cesium, strontium, molybdenum, carbon and iodine would move with water even in reducing conditions.

"The main danger would come with iodine," Grandstaff said. "A small amount of radioactive iodine will get out into the environment. That's inevitable."

In contrast to relatively short potency of the other mobile materials, iodine-129 takes 17 million years to lose half its radioactivity. If ingested, the substance concentrates in the thyroid. Rockwell scientists, who say a release of all the iodine in a repository's spent fuel would not exceed limits, have considered placing "scavengers" like silver in the tomb to lock up iodine chemically.

Yakima Indian Nation consultants said conclusions on geochemistry were "biased and inconsistent with evidence." The Yakima report said fluoride and other organic compounds in Hanford ground water could greatly increase mobility of such long-lived transuranic elements as plutonium, americium and neptunium.

Rockwell's Wood denied bias, however, and said the chemistry of the basalt itself would make fluoride's influence insignificant. Other organic compounds would increase mobility but not above federal limits, he said.

A matter of logistics

By RICHARD READ
of The Oregonian staff

Many logistical obstacles face the Hanford repository proposal in addition to transporting highly radioactive wastes to the nuclear tomb.

The draft environmental assessment issued by the U.S. Department of Energy in December confronted several of these issues while tentatively naming Hanford among the top three sites eligible for further research.

More than 1,200 agencies, groups and individuals responded to the assessment with comments on the site's suitability. Thursday's stories discussed some of the concerns they raised about Hanford's ground water, tectonics, basalt, waste package and location within an existing nuclear complex. Today, other major areas of criticism are discussed.

Among the critics was the U.S. Nuclear Regulatory Commission, the agency that bears final responsibility for assuring a safe site is selected. It submitted lengthier comments on the Hanford draft than on assessments of any of the other eight sites under consideration. Some repeated earlier criticism it had made. But officials admitted to no frustration in having to convey basic concerns over and over.

"There's a document in front of us," said Robert J. Wright, an NRC geologist who is senior technical adviser to the commission's repository projects branch chief. "We simply have a job to do."

TOR

MAY 17 1985

Pg 8 of 9

Natural resources

The blue, banner headline on the front page of November's AAPG Explorer blared "Columbia Plateau Activity Booms." New exploration techniques had opened up sediments beneath Northwest basalts as a "true frontier" for oil and gas exploration, the American Association of Petroleum Geologists newsletter reported.

The development spawned fears that a Hanford repository would lie directly in the path of future drillers seeking invaluable natural resources. Yet in its draft environmental assessment in December, Rockwell Hanford Operations provoked incredulity among reviewers by concluding that "the synclinal areas of the Pasco Basin are poor drilling prospects."

Synclines are geologic formations that bow in the same direction as rails of a rocking chair. Natural gas typically migrates upward to form pools in traps below anticlines, which are bent in the opposite direction to resemble upside-down U's.

Rockwell officials reasoned their synclinal site was bowed the wrong way to trap gas. But in recent responses, the U.S. Nuclear Regulatory Commission and others gave the company a basic geology lesson.

"The comment that there is no gas because there are no anticlines is not necessarily an accurate statement," said Raymond Lasmanis, Washington state geologist and manager of the state Division of Geology and Earth Resources. Curvature of intermediate basalt layers does not necessarily reflect deeper sedimentary formations where gas would pool, Lasmanis said.

A well completed at Saddle Mountain just 16 miles north of the repository site last year by a Shell Oil Co. subsidiary found "substantial amounts of gas," Lasmanis said. Two years of drilling for $15 million made the project uneconomical, and Shell plugged and abandoned the well after setting a state depth record of 17,518 feet, he said.

But the economics of gas and oil fluctuate widely, and at the very least the point was made that sub-basalt reserves exist, various organizations noted in recent comments.

"Close to the reference repository location there was methane gas produced out of the basalt flows," said Lasmanis, referring to an area on the southeast flank of the Rattlesnake Hills seven miles south that produced gas between 1929 and 1941.

Rockwell scientists say chemical tests show that gas "probably originated at shallow depths," but the NRC agreed with Lasmanis that its presence indicated "there could be gas-bearing sediments underneath the basalt." In a recent interview, Rockwell scientists said the comments had forced a "re-evaluation" of conclusions.

The way to settle the matter would be to drill through basalt to sediments and take a look, said Douglas W. Duncan, a former Rockwell advanced scientist who said he and other scientists had to "come up with numbers" estimating basalt thickness in the absence of hard field data. The project budget includes money for drilling such a hole, said Lawrence R. Fitch, Rockwell research and licensing manager.

The U.S. Department of the Interior noted oil and gas are not necessarily the only natural resources that should concern scientists trying to outguess targets of future drillers.

"Think of oil or coal in the pre-Marco Polo western world, or rutile, or uranium or bauxite," Interior officials wrote. "What are considered resources today may not be what people will seek in 5,000 years."

THE OREGONIAN
Portland, OR
MAY 17 1985

Research

The 9,500-acre plot set aside for study of the possibility of locating a repository at Hanford is dotted with cheatgrass and sagebrush and appears deceptively barren.

Actually, researchers have riddled it with 740 boreholes totaling 144,000 feet and have adorned it with about 114 miles of seismic and magnetic lines and 2,000 gravity measurement stations.

Information from the probes is digested by a Rockwell Hanford Operations team of 35 geologists, 24 chemists and geochemists, 23 hydrologists, 21 general scientists, 24 computer operators, seven geophysicists and 36 technicians, 93 engineers, 16 administrators, four editors, seven illustrators, seven schedulers, three public relations officers, 17 records personnel and 33 secretaries and clerks, not to mention subcontractors.

For all that, critiques of the draft environmental assessment assembled by these people raise the question of whether Rockwell scientists look at the world through rose-colored goggles — or even blinders.

Portions of the research document they produced in December were variously criticized as "biased," "badly written," "inaccurate," "optimistic," "unsupported," "too positive," "subjective," "flawed," "inadequate," "blind" and "self-serving" by everyone from the U.S. Nuclear Regulatory Commission to the Environmental Protection Agency to Indian tribes to private citizens.

William A. Brewer, Washington Nuclear Waste Board technical director, is among those who say that "a widely held opinion" exists in the technical community that the primary problem lies not with the research itself but with its presentation. Shortcomings that have cropped up in the basic research may be due to a lack of hands-on commercial experience among scientists, Brewer said.

Reviewers found optimism initially in Rockwell's 1982 Site Characterization Report. Company officials later agreed the report was overenthusiastic and said they had corrected the approach with staff changes, additional review by outside scientists and other measures.

But in a March 6 letter last year, NRC consultant Golder Associates identified fundamental flaws in technical procedures and said a lack of security and quality control surrounding hydrogeology data could jeopardize a Hanford repository's licensing prospects. Ed B. Ash, Rockwell Basalt Waste Isolation Project director, said Rockwell was unaware of the letter until The Oregonian provided a copy recently, but he said some research would have to be redone to meet new NRC standards.

"We are going to have do some of it over, although the vast majority is probably acceptable," Ash said.

The December draft environmental assessment included none of the optimism of previous reports, Ash said.

"We went out of our way to make sure that didn't happen and that it adequately reflected what we don't know as well as what we know," he said. "It's kind of hard to understand how those charges come about."

Part of the problem may be that the law requires judgments be made before all the facts are in, Ash said. Also, the NRC may be particularly critical because it is chartered to play "devil's advocate," he said.

The Rockwell scientists find themselves in a peculiar position, after all, confronting a pressing social problem in a politically charged atmosphere.

If they were using their talents to further a space program, the scientists might be heroes. Instead, they often find their work regarded with public contempt.

Some reviewers, notably the state of Washington, spoke bitterly of "continued delay in receipt of key record documents required for adequate review of the Hanford environmental assessment."

THE OREGONIAN
Portland, OR
MAY 18 1986

C-8
Pg 1 of 4

The Hanford gamble: The river

Downriver population assesses threat to Columbia

The Oregonian CLAUDIA J. HOWELL

HANFORD COMPLEX — Research reactor (stacks at right) is reflected in waters of Columbia River. Reactors in the "100 Area" at Hanford Nuclear Reservation in Washington.

Lifeblood of region at stake

By SPENCER HEINZ
of The Oregonian staff

When red morning sun cuts away the blackness and brings another day and another salmon season, Levi George Sr. gathers his family outside the trailer house 12 footsteps from the Columbia River and issues a prayer slowly in whatever words come to mind.

"We just thank The God for giving us the food for all of our people," the 56-year-old fisherman said of the ritual. "We thank Him for the day, for the water, for the fish and for the hope."

Hope is so big a thing for Levi George, a resident of Toppenish, Wash., because he is one who has spent years considering the implications of living or working downstream of the Hanford Nuclear Reservation.

And because America is trying to decide whether Hanford — as one of three prime sites — should be named as the first permanent repository for 77,000 tons of lethally radioactive spent-fuel rods, the 2 million people downstream are joining George in trying to figure the stakes.

Amid an onslaught of criticisms ("The potential effects of downstream contamination of the Columbia River have been inadequately addressed," the U.S. Environmental Protection Agency wrote in a March 20 critique), ballpark estimates have filled the void.

"Exposure to damage from a repository at Hanford will, I believe, run into the billions of dollars," Washington Rep. Dick Nelson, D-Seattle, told the Energy Department during a recent hearing in Olympia.

Assessing the chances of Hanford contaminating the Columbia River — which unites yet separates Oregon and Washington and is the largest river in volume flowing into the Pacific Ocean from North America — is risky business.

While the U.S. Department of Energy figures radioactive materials would take at least 81,000 years to leak from a 3,200-foot-deep cavern and travel six miles, the U.S. Nuclear Regulatory Commission argues that the same data can be used to show radioactivity could reach the river in 1,000 years.

In a more immediate sense, the river also has proved to be a pathway in past years for seeping radioactive liquids from Hanford and for infrequent barge shipments of nuclear materials.

The U.S. Navy has informed Washington state officials that it would like to start barging to Hanford nuclear reactor compartments — minus highly radioactive reactor cores — chopped from obsolete submarines and contaminated with cobalt-60. And Robert E. Luna, supervisor of the Risk Assessment and Transportation Systems Division of the Transportation Technology Center at Sandia National Laboratories in Albuquerque, N.M., said Sandia was overseeing a nuclear transportation study that assesses risks of barg-

TOR

MAY 18 1985

Pg 2 of 4

ing spent-fuel rods.

"It's looking at mechanics of collisions, rammings, groundings, things like that," he said.

Whatever the risks, the consequences are high.

Lifeblood of the region, the 1,214-mile Columbia's final 343-mile stretch from the Hanford Nuclear Reservation to the Pacific Ocean cuts through $52 billion of assessed valuation in port districts along the way, according to Washington and Oregon revenue department figures compiled by the Columbia/Snake River Marketing Group, a Portland-based economic development organization of 34 port districts.

The Columbia's Hanford reach, which is the last free-flowing segment of the river in the United States, has been considered in recent years for designation under the Wild and Scenic Rivers Act. The Energy Department identifies that section of river as the habitat for bald eagles and 44 species of fish, and as the river's last major spawning area for chinook salmon and steelhead.

Downstream, the Columbia Gorge draws up to 4 million visitors a year, said Jeffrey P. Breckel, executive director of the Oregon and Washington Columbia Gorge panels.

"Looking at the intangible values that we have in terms of recreation," Breckel said, "you could fill books literally on trying to figure out what the value of the area is."

The range of downstream activities is suggested by information gathered from the Columbia/Snake River Marketing Group, the U.S. Army Corps of Engineers, the 1984 Rand McNally Commercial Atlas and Marketing Guide and the Portland Customs District.

The basics are:

- About 2 million people, 1.2 million of them in the Portland-Vancouver area, live within a beadwork of riverside communities. Retail sales account for close to $10 billion in revenue per year.
- Cargoes that moved through the Portland Customs District, which includes ports on the lower Columbia and the seacoast, totaled $4.1 billion in exports and $3.6 billion in imports a year in 1984.
- Freight traffic on the Columbia in 1982, the most recent year with figures available, totaled 15 million tons of cargo moving between ports on the Columbia alone, and 26 million tons of oceangoing cargo.
- Robert C. Petersen, manager for the Port of Ilwaco at the mouth of the Columbia on the Washington side, said annual income to the area from salmon sports fishing has been $7 million to $10 million a year in peak periods. He said commercial fishing brought in about $10 million more.

People are beginning to wonder about what would happen in case of a spill.

"Radioactivity won't stop with just the salmon and steelhead and shad," said Dan J. Guthrie, marine specialist with Oregon State University Sea Grant College in Portland.

"It will continue and go out in the plume of the Columbia. Some will wind up in the razor clams at Gearhart beach. It's not simply a one-species industry that we're talking about."

Recognizing the river's immense regional value, the Columbia River Gorge commissions have asked for a complete environmental impact statement that would deal with the effects of potential spills or seepage of highly radioactive materials into the river.

Although authorities say radioactivity in the downstream Columbia no longer measures above normal background levels, the river, in fact, has been a documented pathway for Hanford radionuclides.

In 1977, the Radiation Control Section of the Oregon Health Division wrote: "The Columbia River, having a distinction in the past of being the most radioactive river in the world, is now no more radioactive than any other surface body of water in the Northwest."

But the issue is heating up again with the startup in November 1983, after a 12-year hiatus, of Hanford's PUREX (plutonium-uranium extraction) plant, and with consideration of Hanford for the spent-fuel repository.

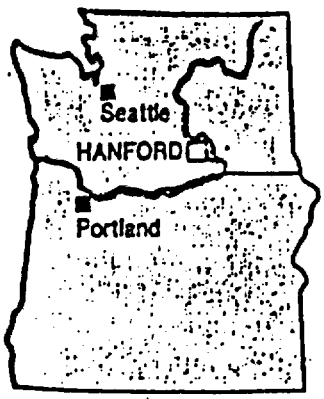
Ron D. Prosser, director of defense waste management with Rockwell Hanford Operations, said PUREX discharged about 8,000 curies a year of tritium — which is radioactive hydrogen — into the ground during the final years of previous operations. During peak years, he said, the discharge levels were greater. He said those curies figures remained classified because they could be used to calculate bomb-production levels.

Prosser added that the tritium actually took decades to reach the river, during which time it continued to decay. Tritium has a half-life of 12.3 years.

During operation of the world's first plutonium-production reactors in 1943 and continuing through 1964, when sequential shutdown of eight reactors was started, Hanford was discharging radioactive materials into the Columbia at the rate of "several thousand curies per day," according to the Oregon Health Division's 1977 assessment.

"By radioactive decay, sedimentation and other natural processes, the majority of the original radioactivity disappeared from the water before reaching the mouth of the Columbia River at Astoria," the report continued.

The river



After cutting through Hanford, the Columbia River travels past more than 2 million people on its way to the Pacific Ocean. It is the largest river in North America emptying into the Pacific.

"We thank Him for the day, for the water, for the fish and for the hope."

THE OREGONIAN
Portland, OR
MAY 18 1985

"However, during prior periods when all reactors were in operation as much as 1,000 curies per day of radioactivity entered the Pacific Ocean at Astoria."

The radioactive substances entered the food chain, which is the pattern of feeding relationships that starts with plants and ends with large meat-eaters, such as humans.

The Oregon Health Division said after the 1971 shutdown of the last wartime reactor, tissues within shellfish, other aquatic life and coastal residents contained zinc-65, although the highest levels were less than 1 percent of the maximum permissible concentrations.

Adding to the picture was a November 1981 report by three Oregon State University Department of Oceanography researchers, who wrote in Science magazine that up to 25 percent of the plutonium-239 in river sediment below Hanford came from Hanford reactor operations. Because it emits alpha radiation, plutonium-239 can do serious biological damage if ingested. It has a half-life of 24,400 years.

In its 1983 Environmental Status Report for Hanford, Battelle Pacific Northwest Laboratory reported that Hanford operations in 1983 discharged into the Columbia River radioactive liquids with low concentrations of tritium, cobalt-60, strontium-90, cesium-137 and 21 other isotopes.

The major contribution, Battelle said, was tritium. Like ordinary hydrogen, tritium tends to combine with oxygen to form water. Tritiated water, like ordinary water, is assimilated into cells throughout the body, which it irradiates with beta particles. Tritium has a half-life of 12.3 years, and it takes about three months for it to be completely excreted from the body following ingestion.

Although the international radiation protection community is considering plans to endorse an increase in maximum drinking water concentrations above the present federal standard of 20,000 picocuries of tritium per liter of water, some scientists believe even the present standard is unsafe.

The March 1984 issue of Bulletin of the Atomic Scientists reported research has shown at levels commonly found in the environment, that "tritium beta radiation was about three times as destructive to developing (mouse) egg cells as cobalt-60 gamma rays, an external radiation source widely used in human therapy."

In November 1983, the Greenpeace environmental organization sponsored tests that found river water samples below Hanford's closed H-Plant with levels about 50 percent above Washington drinking water standards.

W. David McCormack, a Battelle nuclear engineer and health physicist, said he would not advise drinking from the shoreline springs. He added, though, that he believed the contamination level was within less-stringent radioactivity limits for water that is not intended for drinking.

"Radioactivity won't stop with just the salmon and steelhead and shad."

The Seattle regional office of the U.S. Environmental Protection Agency reports that present tritium levels downstream of Hanford are about 200 picocuries per liter of water, compared with the EPA drinking water standard for tritium of up to 20,000 picocuries per liter.

J. Edward Cowan, the EPA's regional radiation control officer, said 200 picocuries was a normal background level of tritium.

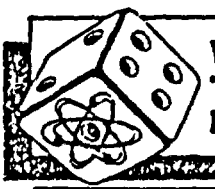
"It means it is about as low as you can go and still detect something."

Yakima Indian Levi George gathers that the river is not in the best shape ever. Neither is it in the worst.

Either way, he says, the Columbia is good to have.

"It is one of the greatest things that ever happened to the people of the Earth," he said.

NEXT: Radiation's effects on workers.



WORDS TO KNOW

Curie — A measure of radioactivity, equal to 37 billion atoms undergoing decay in a second. Low levels are measured in picocuries. A picocurie is a trillionth of a curie.

Half-life — The length of time for half the atoms of a radioactive substance to decay.

Radiation — Particles or energy thrown off by radioactive atoms, also known as ionizing radiation. Consists of alpha particles, beta particles, gamma rays, X-rays and neutrons. Alpha particles are least penetrating but can do the most damage if they are ingested. Gamma rays, the most penetrating, irradiate the body while passing through it.

Radioactivity — The process by which atoms of some substances "decay," throwing off radiation as they do so.

TOR
MAY 18 1985
Pg 4 of 4

Document traces impact of hypothetical 'worst-case' spill

If a cask of highly radioactive spent-fuel assemblies cracked and spilled into the Columbia River near the Hanford Nuclear Reservation in Southeastern Washington, what would be the consequences for the 2 million people in downstream riverside communities?

Although no agency so far has studied comprehensively the range of possible consequences along that final 343-mile stretch of river, a hypothetical example of a "worst-case" spill is described within one of the key documents available so far to nuclear transportation planners.

The 1978 document is "A Generic Assessment of Barge Transportation of Spent Nuclear Fuel," produced by Science Applications Inc. under contract to the National Environmental Studies Project of the Atomic Industrial Forum Inc. The non-profit international association was founded 31 years ago to inform people and help develop peaceful uses for atomic energy.

The barge accident scenario in the report assumes that a river accident — the cause is not stated — cracks a cask containing 10 spent-fuel assemblies from a pressurized water reactor.

For comparison, the Trojan Nuclear Power Plant reactor contains 193 such assemblies. Each weighs 1,395 pounds and contains 264 fuel rods. The rods, in turn, contain the highly radioactive, fingertip-size uranium oxide pellets.

The worst-case accident — which the report gives virtually no chance of ever happening — is of such severity that the fuel rods crack open, exposing fuel pellets to water and greatly increasing the radiation release.

(If the cask didn't crack, there would be no radioactive materials released, although a sealed cask does emit some radiation.)

David A. Stewart-Smith, health physicist with the Oregon Department of Energy and until recently with the Oregon Health Division's Radiation Control Section, said the situation would trigger some obvious emergency responses.

"That would just have to be an unbelievably severe type of accident," he said. "Especially if they consider that the uranium oxide pellets have actually granulized — cracking along their surfaces. I couldn't come up with one that is any more maximum than that one."

First, Stewart-Smith said, every agency that has anything to do with public health, law enforcement, navigation, fishing and irrigation would be mobilized.

Downstream and coastal communities would be told to stop using Columbia River water while further checks were made.

Communities would be told to use only water already in reservoirs. If possible, water from elsewhere would be trucked in.

"Meanwhile, we would have every health physicist in the country taking water samples," he said.

The use of seafood would be limited or stopped entirely. How long a quarantine would last depends on many variables and is one of the biggest unknowns.

It would depend on how much of what kinds of radioactive isotopes were ingested by crabs, clams, salmon and other aquatic life. It would depend on the degree of contamination of algae, sediment and riverbank foodstuffs. It would depend to some degree on economic pressures: Fishing, farming and other livelihoods would be at stake.

Even if contamination levels fell to federally permissible levels, any lingering public perception of contamination in products from the Columbia Basin could temporarily limit or erase their value.

Authorities' immediate goal would be to get the cask and its radioactive materials out of the water. Retrieving the cask and spilled material from the water could take days, weeks or months, depending on the accessibility of the accident location, weather conditions, river level and currents, available equipment and other factors.

After removal of the cask, a major problem would remain because of contamination by radioactive material already discharged from the cask into the running water.

Stewart-Smith said direct radiation emitted by the fuel rods — which would be producing possibly fatal levels of penetrating gamma radiation within a radius of a few feet when removed from the water — would be greatly limited as long as the rods stayed under water, which would help shield emergency workers from radiation.

The long-term problem would be dealing with the effects of soluble radioactive materials already blending into river sediments, entering the cellular structure of algae and being ingested by fish. Radioactive substances can become concentrated in living tissues at hundreds or thousands of times above levels in the water itself. Humans may ingest radioactive-tissue by eating the fish or unknowingly consuming wildlife that has eaten the fish.

The radionuclides that got away would be washed out to sea and diluted eventually to untraceable levels. Some of it would be retained in the Columbia River and coastline food chains.

The river water itself, Stewart-Smith said, might no longer show elevated levels of radioactivity after several months.

The report said the frequency of "severe release" cask accidents during any form of transport was less than one time for every 23 million years of commercial nuclear reactor operations. And for barge traffic alone, the report said, the chances are even smaller.

Estimates are only estimates. Such a nuclear cask-cracking accident in water never has been recorded with the relatively low levels of such shipments today, so there is much leeway for projections.

However, for the Columbia River, a statistical starting point does exist.

Between September 1980 and Aug. 15, 1984, the Columbia River in Oregon and Washington was host to 23 accidents involving 26 barges (hauling non-radioactive cargoes), $67,860 in cargo damage and $861,700 in vessel damage, according to a computer printout on lower Columbia River barge traffic obtained from the U.S. Coast Guard Office in Washington, D.C.

Even if an accident did happen, Stewart-Smith believes, the structural strength of a nuclear-waste cask makes sinking without leaking by far the most likely outcome.

THE OREGONIAN
Portland, OR
MAY 19 1985

C-6

Rockwell manager urges joint effort on nuclear waste disposal problems

By SPENCER HEINZ
of The Oregonian staff

Everyone needs to work together to solve the problem of where to permanently dispose of America's highly radioactive wastes, the general manager of a key government research contractor told the City Club of Portland Friday.

"The problem that we're trying to solve — the handling of radioactive waste — is a tough problem," said Paul G. Lorenzini, vice president and general manager of Rockwell Hanford Operations. "It causes reactions of fear, apprehension and concern. And yet it is a real problem, and regardless of how you feel about nuclear issues, everyone has recognized it's a problem that needs to be solved."

Rockwell Hanford Operations is under contract with the U.S. Department of Energy to evaluate whether Hanford Nuclear Reservation would be a safe place to permanently dispose of an expected 77,000 tons of spent fuel from commercial nuclear plants.

Lorenzini, a nuclear engineer and a lawyer who practiced in Portland in the 1970s before joining Rockwell at the Southeastern Washington nuclear complex, rejected the notion that Rockwell could not objectively evaluate Hanford's safety as a repository because the company stood to make money if Hanford were selected.

"We aren't making a recommendation; we're providing the data," he said. The data amassed by Rockwell will be used by the Energy Department to determine whether Rockwell should proceed with a multimillion-dollar exploration and research program.

Federal role cited

"The DOE (Department of Energy) is the one that's making the decision," Lorenzini said, "and DOE is the one that's making the recommendation."

Lorenzini said that if a repository were built at Hanford, "the major dollars would go" to an architect-engineer and construction management team. "It wouldn't be done by Rockwell," he said.

Lorenzini said there were uncertainties about whether a Hanford repository could keep radioactive materials from traveling with ground water to the Columbia River four miles away. But he said further investigation would deal with those uncertainties.

Hanford was one of three sites that the Energy Department tentatively recommended in December for a comprehensive, five-year study. The others are in Texas and Nevada. The Energy Department is expected to formally recommend three of nine sites this fall for further study.

Lorenzini expressed anger at a Thursday article in The Oregonian that reported two former Rockwell employees said Rockwell had played up data supporting Hanford while de-emphasizing negative findings. The article quoted Douglas W. Duncan — a former Rockwell advanced geologist who is now an Exxon Corp. senior geophysicist in Denver — as saying that Rockwell "filtered" data to show the side of the story the company wanted shown.

Lorenzini told City Club members that Rockwell telephoned the former employees after the article appeared. Lorenzini said Rockwell asked Duncan what information he thought Rockwell had left out of Hanford's massive draft environmental-assessment that the Energy Department issued in December.

Allegation blunted

"He gave us some specifics of some things that he alleged were filtered, and we showed him where that information was in the environmental assessment, and he wasn't even aware of it," Lorenzini told the City Club.

The other former employee, Michael P. Cochran, who left Rockwell to become an Exxon seismic interpreter in 1983, "denies to us that anything like that happened," Lorenzini said. "From everything I know, that allegation is unfounded, it's untrue and it's unfair."

In an interview after the City Club presentation, however, Ed B. Ash, program manager of Rockwell's Basalt Waste Isolation Project, said that Duncan never actually conceded during the phone conversation with Rockwell that the company had presented his conclusions in a way that satisfied Duncan.

Lorenzini modified his position to agree with Ash's statement when advised of it during an interview after the meeting. But he emphasized that Duncan had expressed surprise when Rockwell read sections of the environmental assessment to him.

Lorenzini and Ash said they would try to find out more about the situation. They also claimed The Oregonian had not given Rockwell a chance to respond to the data-filtering allegations before the article was published.

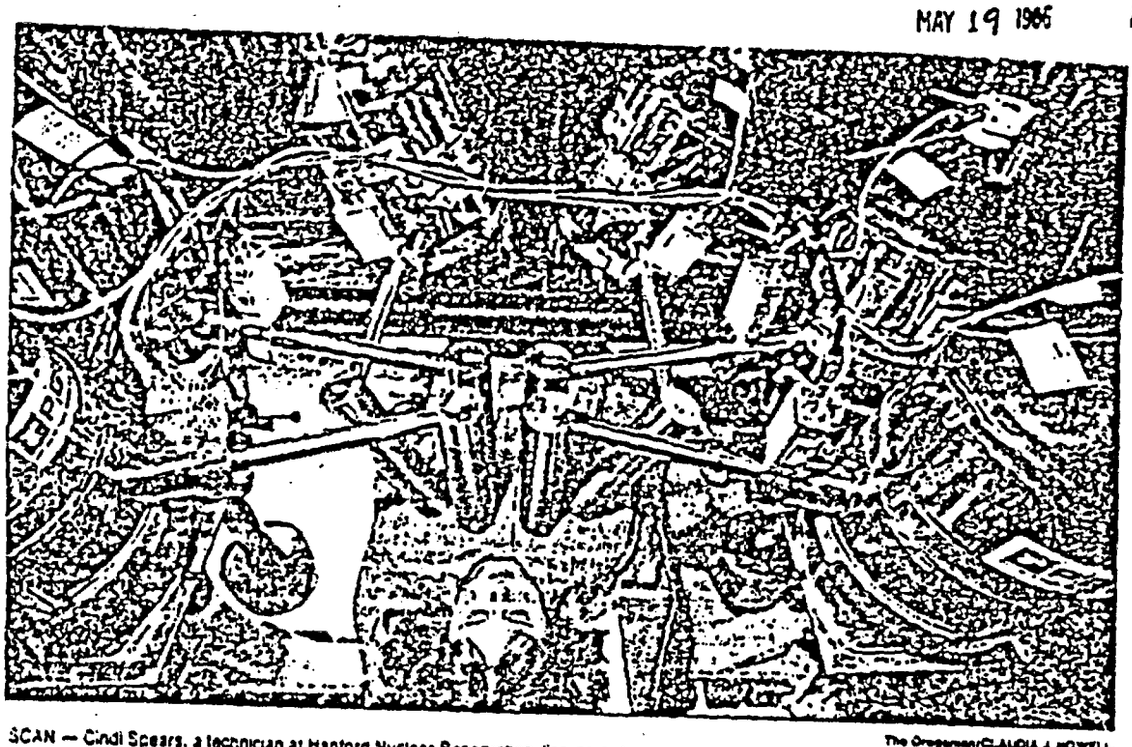
Oregonian reporter Richard Read, who wrote the article, said he telephoned Rockwell before publication and specifically asked Barry C.K. Moravek, Rockwell isolation project communications and public affairs administrator, to arrange a telephone interview with company scientists so they could respond to the allegations. Read said that in the resulting conference call, he asked Moravek, two Rockwell geologists and Lawrence R. Fitch, research and licensing manager of the waste isolation project, to respond to the allegation that the company had filtered data.

"I've been here six years, and I've never seen that happen," Read quoted Fitch in the article as replying.

Peter Thompson, managing editor of The Oregonian, said that he was satisfied that Read's article was accurate and that a response to the filtering allegations was sought in the conference call. Participating in the telephone call were Fitch; Sue M. Price, isolation project geosciences group manager; Ann M. Tallman, project tectonic studies manager; and William H. Price, manager of drilling and testing.

THE OREGONIAN
Portland, OR
MAY 19 1986

A-1
Pg 1 of 6



SCAN — Cindi Spears, a technician at Hanford Nuclear Reservation, lies inside lung counting apparatus that measures internal radiation.

The Oregonian/CLAUDIA J. HOWELL

Hanford safety questions unresolved

Critics call for study on long-range effects of radiation

By SPENCER HEINZ
of The Oregonian staff

RICHLAND, Wash. — At 2:45 a.m. on his graveyard shift at the Hanford Nuclear Reservation, Harold R. "Mac" McCluskey saw a dense brown cloud in the room, and he heard a hissing sound.

There was a flash of light. An explosion slapped his face and shoulders with nitric acid and shards of radioactive metal and glass.

It was Monday, Aug. 30, 1976, and McCluskey had absorbed the largest amount of radioactive material ever taken in by an American nuclear worker. Doctors attended to him immediately and his case eventually became a legend around Hanford.

Doctors are still monitoring McCluskey, who now is 72, for long-term effects. But the known details of McCluskey's intense exposure contrast today with the uncertainties about the effects of low radiation levels on Hanford workers and the surrounding population.

Spurred by Hanford's consideration as a national nuclear waste disposal site, residents downstream and downwind are questioning whether Hanford radioactivity is reaching them today, whether it would reach them if Hanford becomes the nuclear repository and whether it would affect their health and their businesses.

"What is the real risk of polluting the Columbia River and what kind of assurance do we have?" said William S. Naito, a downtown Portland developer. "That, I suppose, is the bottom line."

There are some known factors:

• Four decades after Hanford began discharging radioactive gases and particles into the air and water, no independent and comprehensive study of the potential health effects upon the regional population has been performed.

U.S. Department of Energy officials and its contractors at Hanford say such a study is not needed because radioactivity outside the site normally cannot be detected above natural background levels.

Critics say a human study is the only course, and they point to puzzling hints that cancer rates in Eastern Washington areas downwind of Hanford may be above statewide and national levels.

"I don't know what else as citizens that we can do but count bodies," said Joan N. Mootry, a Spokane artist and former Hanford-area resident who one year ago helped found the Hanford Education Action League, a citizens watchdog group of physicians and others who believe Hanford is threatening the regional health.

• Forty-one years after Hanford was created to help make the first atomic bomb, some officials believe that environmental monitoring to protect

TOR

MAY 19 1985

Pg 2 of 6

public health is only a fraction of what is necessary. Terry R. Strong, head of the Radiation Control Section of the Washington Department of Social and Health Services, said the state should spend about $2.5 million a year instead of the present $87,000 to monitor Hanford independently.

• Studies of Hanford workers have shown an apparent connection between low radiation doses they receive and deaths from multiple myeloma, a bone cancer. In other studies that have sparked heated worldwide debate, a few researchers claim those Hanford workers are experiencing 5 percent more cancer deaths than should be expected.

"If they stick to present safety levels, they will have more trouble than they think they are going to have," said Dr. Alice M. Stewart, a British physician who helped perform the controversial Hanford studies.

In almost total contrast, studies by Battelle Pacific Northwest Laboratory at Hanford under contract with the U.S. Department of Energy say that multiple myeloma aside — which Battelle researchers believe could be a statistical anomaly that will disappear in time — there is no excess of cancers at Hanford and that workers face no extra dangers of genetic damage.

"I wouldn't hesitate to go into PUREX and into those jobs and go ahead and have those kids," said Dr. Sidney Marks, a pathologist who oversees Hanford's worker-death study for Battelle. PUREX refers to the plutonium-uranium extraction plant at Hanford.

For the average Northwest resident, the question of Hanford's radiation danger is ripe for manipulation by both sides because of radiation's mystique and because scientists are raising such a fuss among themselves.

In one camp are scientists employed by the Energy Department or its subcontractors, and in the other camp are activists armed with photocopiers and the findings of a half-dozen widely published scientists.

Within that contentious atmosphere, all of the scientists believe that Hanford workers are a bellwether population, the early warning of potential radiation effects on the region's people.

Related stories on Page C3.

How radiation standards have been modified

Recommended maximum doses of ionizing radiation have dropped as radiation's negative effects became apparent. Doses initially were measured in Roentgens, the amount of X-ray or gamma energy in the air. The yardstick eventually changed to rems, which take into account other types of radiation and also reflect how much radiation the body absorbed and radiation's biological effect. In the case of X-rays and gamma rays, one Roentgen is roughly equivalent to one rem.

The independent National Council for Radiation Protection and Measurements and the International Commission for Radiological Protection set recommended exposure standards, which governments use as guidelines for their own regulations.

Year	Exposure
1934	36 Roentgens (NCRP) 72 Roentgens (ICRP)
1948	15 rems
1956	5 rems

Source: Lauriston S. Taylor, who headed NCRP from its founding as a committee in 1929 until 1977.

The Oregonian

THE OREGONIAN
Portland, OR
MAY 1 0 1986

Pg 3 of 6

The Hanford gamble: Radiation

Inbred system of nuclear research raises doubts

Eighth in a series

By SPENCER HEINZ
of The Oregonian staff

Counting on the makers of America's nuclear weapons material to produce trustworthy health studies is precisely as reasonable, critics say, as relying upon public health agencies to make trustworthy nuclear weapons.

Public health agencies do not make nuclear weapons.

That leaves questions about the U.S. Department of Energy.

Reflecting national security interests, the U.S. Atomic Energy Act of 1954 requires the Energy Department to make nuclear weapons material and also to do studies of whether that work is causing radiation problems for workers and the public.

Critics believe the weapons-makers thus have a stake in finding no radiation health effects, since finding them could require extra radiation-protection measures and increase the cost of weapons production.

Despite arguments from Energy Department scientists — who say they work hard to produce objective studies and that they would be foolish to allow radiation exposures that could also hurt themselves and their families — critics say they will continue to question for these reasons:

• Although international radiation authorities have said each step of the way that the exposure limits they were proposing were not harmful, since the 1930s those standards have dropped dramatically as cancers have become evident. In the 1940s, the word "safe" to describe recommended dose limits was changed to "permissible."

"It's pretty much a uniform trend," said William E. Morton, professor of environmental medicine at Oregon Health Sciences University. "The more we see, the smaller the doses we recommend to people. I don't know where the end of that will be."

• The Energy Department provides more than half of the money spent nationally for radiation health effects studies, according to a 1981 report by the Committee on Federal Research on the Biological and Health Effects of Ionizing Radiation. Robert J. Alvarez of the Environmental Policy Institute of Washington, D.C., and other critics say that gives the Energy Department purse-string control over many studies that are used as benchmarks to determine radiation-exposure limits for nuclear workers and the public.

• Because Energy Department contractors in some cases derive much of their annual incomes from the Energy Department, there is potential bureaucratic inertia to produce health findings not disturbing to employers.

The key death-rate study of Hanford workers is overseen by Battelle Pacific Northwest Laboratory at Hanford. The company says it expects this fiscal year to receive $172 million — close to 80 percent of its entire annual budget — from the Energy Department.

• Because of the Energy Department's national defense mission, Congress has given the agency the power in some situations to make significant changes in its own standards relatively free of public oversight. For example, after soliciting the advice of other federal agencies — but without a public hearing or notice in the Federal Register — the Energy Department last year raised by 10 times the allowable concentrations in shallow landfills for plutonium-contaminated wastes and other long-lived transuranic, radioactive trash.

David B. Leclaire, director of the Energy Department's defense waste and byproducts management office, said that the radiation protection community — not just the department — believed the new standard provided easily enough health protection while saving taxpayers the expense of deep burial in some cases. But, critics say, the decision about whether there was a proper balance between protecting the public health and conserving weapons-making dollars should not have rested with the weapons-makers.

Although the Energy Department is subject to a slew of bureaucratic checks by other agencies, there are some cases in which standards are not much more than flexible guidelines.

For example, if the Energy Department finds it needs to exceed the new Environmental Protection Agency standard that limits airborne radiation doses to the public to 25 millirems a year, the Energy Department can ask the EPA for waivers allowing occasional public exposures up to 500 millirems. That compares with the average annual background radiation exposure of about 100 millirems. A millirem is a measurement of how much radiation is absorbed and its potential for damage.

According to the new EPA standard, the EPA "will" comply with the waiver requests once criteria have been met.

The airborne radiation standard evolved only after a federal judge found outgoing EPA chief William D. Ruckelshaus in contempt of court last December. U.S. District Judge William Orrick took that action after the EPA — despite its confirmation that radiation causes cancers and genetic defects — announced that it would not enact any standards.

Ruckelshaus contended that Energy Department internal guidelines to keep radiation exposures "ALARA" — as low as reasonably achievable — offered sufficient public protection. Those non-mandatory ALARA guidelines are aimed at reducing "exposures to the lowest levels commensurate with sound economics and operating practices," according to the department's ALARA guidebook.

The Energy Department had fought against imposition of any EPA standards by saying they would do nothing more to protect the public health and would open the fiscal floodgates.

"Currently, there are numerous lawsuits pending against the government and its contractors alleging billions of dollars of damages from exposure to low levels of radiation," wrote Alvin W. Trivelpiece, director of energy research for the U.S. Department of Energy, in a July 14, 1983, letter to the environmental agency.

"It is almost certain that if the proposed EPA standards for DOE facilities

are finalized, the number of lawsuits will increase dramatically and, regardless of eventual outcome, the government's litigation costs will substantially increase," Trivelpiece added.

EPA drinking water standards also say the amount of radioactivity in water must not produce a cumulative dose of more than four millirems in a year if a person were to drink 2 liters each day.

J. Edward Cowan, EPA radiation representative for the Northwest regional office in Seattle, said he recalled no time that Tri-Cities drinking water has exceeded radiation standards. Cowan said the off-site airborne dose from Hanford to the most exposed individual has been calculated by the Energy Department to be less than one millirem a year — far below the new off-site limit of 25 millirems.

The Energy Department's own reports generally show that it is doing a good job of protecting the public health. But faced with concerns about in-house nuclear studies and occasional standards that have no teeth, Rep. Timothy E. Wirth, D-Colo., has proposed a law that would transfer authority for radiation health research from the Energy Department to the Department of Health and Human Services.

Wirth aide Steven J. Coffin said his office was not questioning the sincerity and dedication of Energy Department scientists or their contractors, but rather the inbred nature of the system.

"Until we have somebody doing objective studies," Coffin said, "workers and the public are going to be kept under a cloud of uncertainty."

NEXT: Radioactivity, radiation and how Hanford affects the Northwest.

TOR

MAY 19 1985

Pg 4 of 6

The Hanford studies

Scientists debate radiation effects

The rather humorless field of radiation research is best described with this formula:

The lower the level of radiation, the greater the amount of bluster scientists will expend arguing about its effects.

For example, if a freak accident left a person completely exposed to a spent-fuel assembly producing thousands of rems of radiation per hour, there would be no argument about the radiation effects: immediate death from a short-circuited central nervous system.

But with low levels of radiation — below the maximum permissible whole-body dose of five rems a year for nuclear workers — there is plenty of room for argument because any radiation effects may not become evident for decades. The presumed effects range from none at all to excess cancers and birth defects — depending on which camp of scientists is doing the analysis.

In 1977, publication of a controversial report on cancer deaths in the Hanford worker population sparked the worldwide discussion of low-level radiation effects.

Today, the issue is badly polarized, and the fighting persists.

If the handful of critics of existing standards is right, and the mainstream scientific community is wrong, unknown numbers of people are dying from low but perhaps preventable exposure to radiation.

The chief studies purporting to show such effects were done by Dr. Thomas F. Mancuso of the University of Pittsburgh, in conjunction with Dr. Alice M. Stewart and statistician George W. Kneale of the University of Birmingham in England. In reports and updates issued since 1977, the three contend that workers are experiencing 5 percent more cancer deaths than one should expect in a relatively young and healthy worker population.

They say that would mean the cancer risk from low-level radiation is from 10 to 25 times greater than commonly accepted.

Their MSK studies (named after the authors' initials) are among the most controversial of all documents in the world of health physics. Leading the mainstream scientific community's charge against the MSK findings are two Hanford researchers: Ethel S. Gilbert, a statistician and staff scientist with Battelle Pacific Northwest Laboratory's energy systems department; and Dr. Sidney Marks, associate manager of Battelle's environment, health and safety research program.

Unfortunately for the average person who wonders about being damaged from something unfelt and unseen, the teams of Gilbert-Marks and MSK have looked at the same nuclear worker community and arrived at dramatically different conclusions in key areas.

Whereas the MSK scientists believe Hanford occupational radiation risks are at least 10 times greater than commonly believed, Gilbert and Marks — together with most of the world radiation-protection establishment — hold that the MSK studies have jumped to conclusions and that there is no reason to tighten radiation guidelines.

The two sides do agree on at least one thing: There is a small but statistically significant appearance of a bone cancer called multiple myeloma in the Hanford worker population, and it may be associated with exposures to low external doses of radiation.

(The latest published Gilbert-Marks figures, which include deaths through Jan. 1, 1979, show seven such deaths among 15,992 white male workers employed at Hanford at least two years. Using a broader worker sample, the MSK studies found 10 such deaths among Hanford men.)

The two sides do not agree on the import of the multiple myeloma incidence.

The MSK scientists predict that a variety of fatal cancers will follow as more Hanford workers approach the ends of cancer-latency periods, which

THE OREGONIAN
Portland, OR
MAY 19 1985

The Oregonian/CLAUDIA J. HOWELL

SAFETY CHECK — David Stark, radiation protection technologist, uses a radiation detection device to "frisk" lead nuclear chemical operator Otis W. Dennis. They are in Hanford's "200 East" area.

DR. SIDNEY MARKS

can range from about five to 40 years.

Conversely, Marks and Gilbert believe that there is barely any increase now and that continued observation of the Hanford population may in fact show the present multiple myeloma increase to be a false statistical reading.

The two teams reach those different conclusions about health effects in part by using different statistical methods.

Gilbert, who was awarded the prestigious George W. Snedecor Memorial Award in 1979 from the American Statistical Association for her Hanford worker studies, notes that Hanford workers actually have experienced a lower cancer death rate than the general American population.

(Hanford's white male workers die from cancer at only about 80 percent the rate among white men in the general U.S. population, she said. The most recent published Gilbert-Marks figures show 512 cancer deaths among 15,992 white male workers employed at Hanford at least two years, through 1976. Using data on every Hanford worker from 1944-77, MSK found 747 cancer deaths among 21,878 male workers.)

MSK's Stewart, who received international acclaim for demonstrating the health dangers of X-rays on fetuses, concedes that compared with the general American population — which includes the old and the infirm — Hanford workers are experiencing a lower cancer death rate.

But she says if one considers the relative youth of the Hanford worker population, more workers than expected have died from cancer. In other words, Stewart says, Gilbert and Marks are not compensating enough for the "healthy worker effect."

Meanwhile, a collection of studies elsewhere adds shadings to the debate over low doses of radiation.

Dr. Carl J. Johnson, former director of Colorado's Jefferson County Health Department, said emissions from the Rocky Flats nuclear complex near Denver have exposed some downwind Denver residents to as much as 278 times more plutonium per gram of soil than state and federal agencies had reported.

Although his methods have been vigorously criticized by the mainstream radiation-protection community, Johnson's reports in recognized scientific publications conclude there was an excess of almost 500 cancer and leukemia cases downwind of the Rocky Flats plant during an initial study period from 1969 to 1971. He believes the figure will grow to 12,000 by 1990.

The Environmental Policy Institute, a national public interest research and information group that has been critical of U.S. Department of Energy health studies, has used the Freedom of Information Act and other vehicles to compile a recent report that includes these points:

- At the Oak Ridge, Tenn., Y-12 weapons plant, researchers have found a "statistically significant" excess death rate from cancers of the lung, brain, lymph nodes, bone marrow and central nervous system when compared to the general public.
- An excess death rate from malignant skin cancer is occurring among workers at the Lawrence Livermore National Laboratory for nuclear weapons research in Livermore, Calif.

Dr. Clarence C. Lushbaugh, who helps oversee Oak Ridge Plant studies and others as chief of radiation medicine with the Medical Health Sciences Division of the Oak Ridge Associated Universities in Tennessee, said in an interview that those were preliminary, informal reports subject to change as more information came in. He added that it was too early to say if radiation had any connection to the cancers.

TOR
MAY 1 0 1985
Pg 6 of 6

. . . As political infighting still clouds worker cancer findings

In 1974, the nuclear industry was shaken by a scientific and political bombshell, the fallout from which continues to cloud discussions of whether low but perhaps preventable doses of radiation are killing people.

The bombshell hit when Dr. Samuel Milham Jr., a physician with the Washington Department of Social and Health Services, quietly advised the federal government that white men working at the Hanford Nuclear Reservation seemed to be experiencing more deaths from cancer than white, male Washingtonians in other occupations.

In 1977, a follow-up study by a joint U.S.-British team concluded that Hanford workers indeed were experiencing at least 5 percent too many fatal cancers when compared with levels expected in an otherwise young and healthy worker population.

If true, that would mean potentially a huge liability and refitting costs for the nuclear industry.

With that, the stage was set for a political mess that still engulfs the 1977 study, which was done by Dr. Thomas F. Mancuso of the University of Pittsburgh, and Dr. Alice M. Stewart and statistician George W. Kneale of the University of Birmingham in England.

The political problems started when the U.S. Atomic Energy Commission — which had hired Mancuso 10 years earlier to conduct worker death studies at Hanford and other nuclear centers — canceled his contract and transferred his data to in-house scientists after he refused to rebut Milham's findings and partly confirmed them.

"I've been brutalized," Mancuso said recently.

Did the government cancel his contract, as Mancuso claims, because he refused to minimize or cover up evidence of potential excess cancer deaths at Hanford? The answer depends on the interpretation given to events since then:

Federal documents and recollections by the principals show that, shortly after Milham notified the Atomic Energy Commission of his apparent excess cancer findings in 1974, Dr. Sidney Marks — who was a commission employee and Mancuso's contract officer at the time — telephoned Mancuso's secretary. Marks read to her a proposed news statement prepared by the commission's public relations department to answer expected press inquiries about excess cancers.

The statement said Milham's report was "contrary to a wealth of information" already in hand.

Mancuso said he refused to sign off on the proposed response to the press because, to his mind, Marks essentially was asking him to reject Milham's findings without benefit of further study.

Marks responds now that he simply was offering Mancuso the chance "to correct any errors" and that he does not recall that Mancuso was disturbed about the wording at the time. In any event, the proposed statement was not released to the press.

During the next three years, three things happened:

- With Marks as Mancuso's contract officer, the government in 1977 terminated Mancuso's contract and within weeks gave the Hanford piece to Battelle Pacific Northwest Laboratory at Hanford, according to federal documents.
- The government published a Federal Register announcement and granted Marks — who is a medical pathologist and who holds a doctorate in biostatistics — an exemption from federal conflict-of-interest rules. That allowed him to go from his government job and eventually take over the Mancuso study for Battelle.
- Mancuso, Stewart and Kneale published the 1977 report in the scientific journal Health Physics that claimed low levels of radiation caused excess Hanford cancers. The article appeared shortly after Mancuso's contract ended, but he had been notified two years earlier that it would end.

In a recent interview, Marks said the coincidental timing of the various events should not lead people to believe that Mancuso lost the study contract because of failure to rebut Milham's report of excess cancers. Marks said Mancuso's peers were dissatisfied with his work well before Mancuso's 1977 report claimed there were excess cancers among Hanford workers. Marks said Mancuso in previous years had, in fact, been finding no excess cancers, and that he should have been leaving clear evidence of that by publishing progress reports.

"In other words," Marks said, "the dissatisfaction didn't stem from the negative results or the positive results. It was the fact that he wasn't expeditious in proceeding with the work and he wasn't making his methods available for review by the scientific community."

Mancuso replies: "The reasons they gave for taking it away were found in the congressional hearing to be false."

In fact, there were at least three investigations of allegations that the government tried to cover up excess cancers among its nuclear workers by sacking Mancuso:

- Following a February 1978 series of hearings on the matter by the U.S. House of Representatives Subcommittee on Health and the Environment, the hearing chairman, Democratic Rep. Paul G. Rogers of Florida, advised Secretary of Energy James R. Schlesinger in a letter that the switch from Mancuso to Battelle created a possible conflict of interest, "reflects serious mismanagement and is of questionable legality."
- A follow-up investigation by the inspector general of the Department of Energy, a successor to the Atomic Energy Commission, found no wrongdoing associated with the Mancuso dismissal and related incidents.
- In a third investigation, the U.S. General Accounting Office said the Energy Department failed to provide enough documentation of its reasons for dropping Mancuso's contract. On the other hand, "it is certain that the department was very concerned about the conduct of Dr. Mancuso's study and was seriously considering replacing him years before the Washington state researcher's findings were known."

The GAO decided that Battelle at Hanford in fact was capable of carrying on the Mancuso research but concluded: "In GAO's view, the significant problem associated with the department's selection is the image that results when the agency developing and improving nuclear power through contractors uses these same contractors to study the safety of nuclear power."

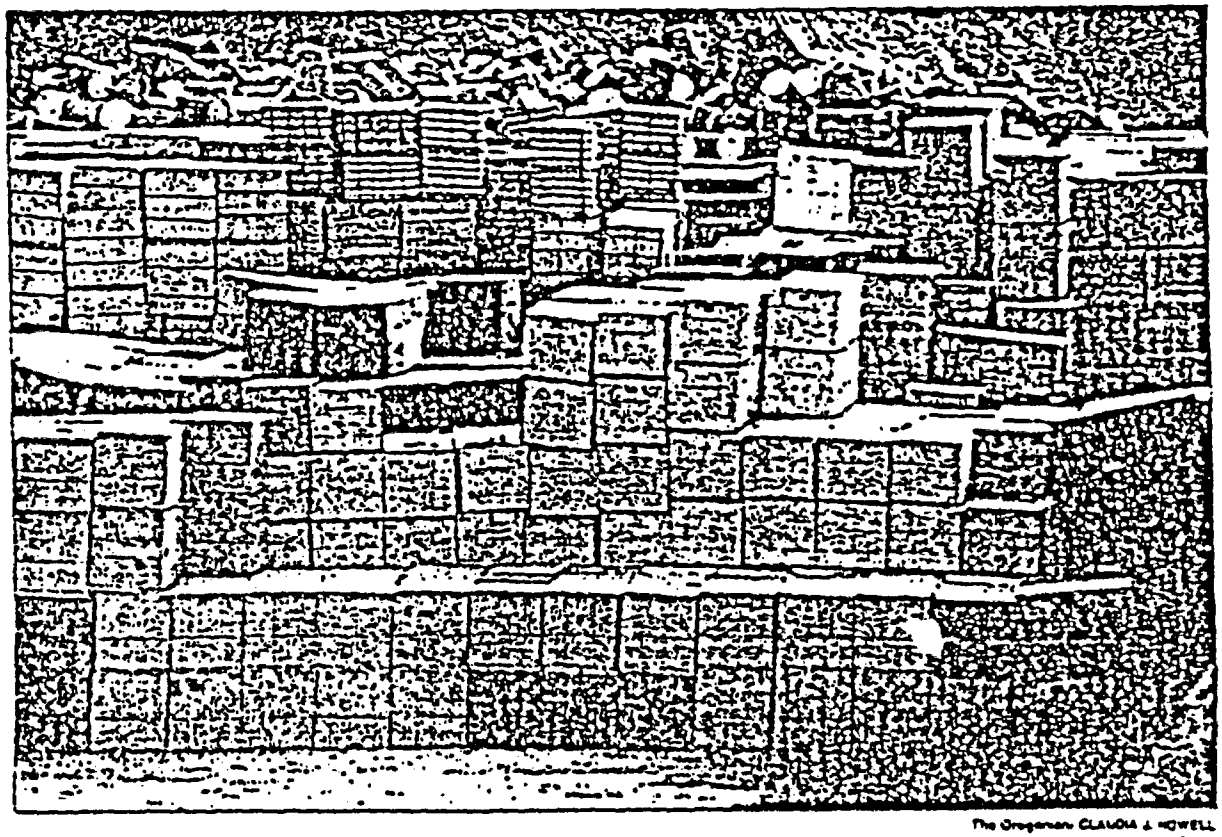
"It's still clouded by the politics," Milham said. "I'm just kind of sorry I started the whole thing."

THE OREGONIAN
Portland, OR
MAY 20 1985

A-8
Pg 1 of 9

The Hanford gamble: Radiation

Debate swirls around danger of plutonium releases



The Oregonian CLAUDIA J. HOWELL

RADIOACTIVE WASTE — Boxes and barrels of low-level nuclear waste fill trenches managed by U.S. Ecology Inc. at Hanford Nuclear Reservation in Southeastern Washington. Hanford, about 30 miles north of Oregon, has become one of the world's largest nuclear complexes

Ninth in a series

By SPENCER HEINZ
of The Oregonian staff

RICHLAND, Wash. — Like a good sniper, plutonium waits.

With a radioactive half-life of 24,400 years for plutonium-239, time is on its side.

And, if indeed it kills, it does so randomly.

As a heavy, dark-green powder that gives life to nuclear weapons, plutonium is at the center of a debate over whether its Hanford production also is killing people quietly by inducing cancers.

The U.S. Department of Energy says Hanford routinely releases plutonium and other radioactive materials and gases into the environment.

But the agency claims the releases are within concentration guidelines and are further diluted by wind or water to insignificant levels before they get to regional residents.

Critics want medical proof that people are not being harmed.

The agency has not provided it — at least to the satisfaction of those who keep looking deeper for the answers, like peeling open an onion, one layer at a time.

—

Dr. Bryce D. Breitenstein Jr., president of the occupational health clinic known as the Hanford Environmental Health Foundation, said plutonium particles probably caused cancer in humans — but that there was no absolute proof.

"There's never been an observed health effect in humans that I'm aware of," he said.

That statement riles Dr. John W. Gofman, co-discoverer of uranium-233, professor emeritus of medical physics at University of California at Berkeley and one of the decade's most vocal critics of the nuclear industry.

"He's correct in drawing that fine line," Gofman said of Breitenstein, "but overwhelmingly irresponsible."

Gofman said medical literature contained many examples of radium ingestion causing cancers in luminous dial painters. He said there was no great difference between the bone-seeking properties of both plutonium and radium. As a result, Gofman said, it is wrong to imply that there is even the most remote chance that plutonium does not also cause cancer in humans.

Breitenstein replies: No question about it, plutonium in the lungs is dangerous. But everyone in the world has traces of plutonium in them from nuclear weapons fallout, and risks are relative, he said.

"I would rather have a particle of plutonium in my lung than smoke a pack of cigarettes," Breitenstein said. "I'm as fanatic about smoking as Gofman is about plutonium."

In a rather slippery area, there is some solid ground.

TOR

MAY 20 1986

Pg 2 of 9

Roy C. Thompson, a senior staff scientist in the biology and chemistry department of Hanford's Battelle Pacific Northwest Laboratory, said continuing examination of hundreds of beagles — which were injected with or which inhaled plutonium particles much smaller than a pinprick — reveals this:

Plutonium seems to be about 15 times more hazardous in effects on bones than notoriously cancer-causing radium.

Thompson said an earlier study with higher plutonium levels caused cancer in virtually every dog tested.

Studies are continuing.

C

Onion layer No. 2: Are plutonium and other radioactive materials leaving Hanford and getting to the people in the region?

Again, a remarkable level of controversy.

But for a starting point, Battelle reports that some ducks, rabbits and deer have become slightly radioactive from certain Hanford ponds contaminated by past nuclear operations. Radioactivity in animals can lead to exposure of humans who may unknowingly eat the contaminated foodstuffs.

Battelle, which is under contract with the U.S. Department of Energy at Hanford, calculates that the biggest off-site radiation dose a person could get from Hanford would be one millirem a year compared with the U.S. Environmental Protection Agency's limit of 25 millirems a year.

Battelle also calculated an average dose attributable to the Hanford operation for the 340,000 people who life within a 50-mile radius of the reservation and that came to 0.01 millirems a year, which is 1/10,000 of the average natural background radiation levels of about 100 millirems a year.

Those figures have drawn much criticism.

"This data is based on Battelle's environmental surveillance studies with no independent confirmation; we simply do not believe these results," Dr. Bruce Amundson, a Spokane physician representing the Eastern Washington Chapter of Physicians for Social Responsibility, said during a recent repository hearing in Spokane.

"Since no soil studies of plutonium or other highly toxic long-lived radionuclides have been performed in our area, we are unable to assess objectively the degree of existing contamination," Amundson added. "This is an indefensible fact, more than 40 years after the opening of a nuclear reservation the size of Hanford.

"We are blithely reassured that nuclear residue does not flow beyond the boundaries of the reservation in spite of the fact that plume patterns have been extensively studied from other nuclear stacks, showing dispersal of radioactive particulates and gases for great distances."

Hanford officials acknowledge that their figure for off-site radiation dosage is only an estimate.

It has to be, they say, because radioactivity outside Hanford is so low it cannot be detected with instruments.

Instead, they use production-plant stack emissions and other known quantities to calculate how much of the radioactive materials could be dispersed throughout the region.

But critics dispute the calculations of average doses.

They believe the plumes of radioactive materials may sometimes encounter weather conditions that cause them to leapfrog over some communities and come to Earth hundreds of miles away, creating radiation hot spots.

They point to the Jan. 9, 1984, testimony of William F. Lawless, a former Energy Department waste management researcher at the Savannah River nuclear complex in South Carolina, 20 miles downstream from Augusta, Ga. Lawless said that an experimental release from Savannah River of krypton-85 gas surprised officials because the plume stayed largely intact before settling about 175 miles away at Fayetteville, N.C.

"What this piece of research indicates is that a lot of people will not receive any radiation, but where the plume passes, those people will receive more radiation, more of a dose," he said while appearing as a witness during a trial of protesters arrested for trespassing at the Savannah River complex. "And over a period of time, as the plume passes overhead, you can build up more and more, you will receive more and more radiation."

Allen B. Benson, a chemistry instructor at Spokane Falls Community College and one of the most persistent regional critics of Hanford activities, said the Savannah River experience was among factors that led him to believe Hanford was allowing plutonium particle emissions in concentrations 4,000 times greater than guidelines recommended by the International Commission for Radiological Protection.

Benson, together with the Hanford Education Action League, a Spokane-based citizens watchdog group of physicians and others who believe Hanford is threatening the regional health, used the Energy Department's 1983 Battelle data on Hanford emissions to conclude recently that the Eastern Washington community of Sunnyside, 20 miles southwest of Hanford, contained up to 55 micrograms of plutonium per acre, which translates to about 3.4 million picocuries per acre.

Benson said Hanford soil itself contained up to 1,700 micrograms of plutonium, which translates to about 104 million picocuries per acre.

A microgram is one millionth of a gram, which is a measure of weight. A picocurie is one trillionth of a curie, which is a measure of the amount of radioactive material.

The levels were beneath U.S. Environmental Protection Agency limits. But they were elevated enough for Benson to ask for an independent study of whether Hanford is adding appreciably to the region's share of worldwide nuclear weapons fallout.

Benson and others point to the studies of Dr. Carl J. Johnson, former director of Colorado's Jefferson County Health Department, who has claimed amid much criticism that plutonium emissions from the Rocky Flats nuclear complex near Denver will cause up to 12,000 more cancer cases than otherwise would occur by 1990 among downwind residents. Johnson has agreed to help study the Hanford region.

"Human lives are in jeopardy in terms of this question," Benson said.

"Certainly I wouldn't live here if I thought there was a health hazard," retorted Keith R. Price, a health physicist and manager of the Battelle environmental monitoring program at Hanford.

He said Benson's figures were accurate but misleading. Price said that Battelle took only one 6-inch soil sample from the Sunnyside area in 1983 and that Benson extrapolated to produce the estimated plutonium concentrations per acre.

What's to come

Tuesday: Waste politics and how Hanford fits in.

Wednesday: Washington and Oregon responses.

Thursday: Nuclear boosters and opponents.

Friday: Who profits from the process.

Saturday: National defense and spent-fuel politics.

Sunday: Science tries to dispose of nuclear waste.

The eight-year average, Price added, is half the 1983 plutonium level.

"The little bit of plutonium that is being deposited in the soil from Hanford is being overwhelmed by the fallout from nuclear weapons tests," Price said, adding that the plutonium particles "tend to settle out within a few miles."

Jofu Mishima, a Battelle staff scientist who specializes in airborne particle behavior, echoes Price while not ruling out the possibility that plumes — at least over much shorter distances than noted by Lawless — can leapfrog.

"There could be this phenomenon where it would skip a location," he said.

Because neither Washington nor Oregon has central cancer registries, health officials say it is extremely difficult to tell if any connection exists between Hanford radioactivity and regional cancer rates.

Lacking any centralized tracking mechanism — which would show numbers, types, geographical locations and other details about cancers per 100,000 population — regional residents are left only with scattershot clues. Although most epidemiologists and physicians on both sides of the issue generally emphasize that there is no absolute proof of anything unusual happening in the region, the fragmented data that are available contain enough statistical bumps to keep it a wide-open question:

• "The cancer death rate in Eastern Washington has been consistently higher than the cancer death rate for the state and the nation," according to data reprinted in the current health status report produced by Eastern Washington Health Systems Agency based in Spokane. "Currently, over 20 percent of all deaths are attributed to cancer, and the trend seems to be rising."

But those data, while some of the most recent available, cover only the years from 1974 through 1977 and do not include any statistics from the Tri-Cities next to Hanford. Janis R. Sigman, assistant director in charge of planning and project review for the agency, said it would be irresponsible to use such unspecific data to draw any conclusions about the public health effects of Hanford operations.

• Overall cancer death rates in the Tri-Cities' Franklin and Benton counties seem "real close to the state averages" but do include a puzzling increase in cancer deaths among Franklin County women, said Robert D. Hughes, senior health planner with Central Washington Health Systems Agency in Yakima.

Hughes said 1982 rates that have not been adjusted for population age differences showed a statewide cancer death rate of 172.6 persons per 100,000 population compared to only 131.6 in Benton County and 113.3 in Franklin County — two counties that have relatively young and healthy working populations.

Hughes added that he had noticed "a huge increase" in fatal cancer deaths for Franklin County women in more realistic age-adjusted rates. They showed 94.3 women cancer deaths per 100,000 population in the 1968-71 reporting period, compared with 170.9 for the most recent available reporting period in 1976-79.

"I think it's the highest county rate in the state, and I don't know why it's there," Hughes said. He said it was puzzling because in the same period, the cancer death rate for Franklin County men went down.

He said such statistical contradictions could mean nothing unusual was happening. "Men going down sharply and women going up even more sharply — what it means is anyone's guess," he said.

• The proportion of deaths from cancers among Hanford workers appears to be rising, although that could mean simply that fewer Hanford workers are dying of heart disease or other typical ailments, said Dr. Samuel Milham Jr., a physician who heads the Epidemiology Section of the Washington Department of Social and Health Services. Milham said 30 percent of all Hanford worker deaths were from cancer compared with only 22 percent through about 1980.

"Either you have a true increase in cancers," he said, "or you have a decline in something else."

Various regional interest groups, meanwhile, are demanding independent investigations of the extent of radioactive contamination of soils, independent monitoring of Hanford stack emissions and independent examinations of cancer incidence, infant deaths and genetic abnormalities.

"Long-term damage to the genetic pool of our population must be considered as no less significant than the immediate health issues," Amundson said.

Milham said he doubted expensive health studies would show anything if Hanford's extremely low estimates of off-site radiation doses were accurate.

"There's no way to tell the forest from the trees," he said.

British physician Alice M. Stewart thinks the region should be trying.

"You know what all the 'safe' industries are?" she asked. "All the ones that haven't been studied."

NEXT: Hanford and waste politics.

THE OREGONIAN
Portland, OR
MAY 20 1985

TOR

MAY 20 1985

Pg 4 of 9

Explosion knocks man into record books

Eight years after the explosion, Harold R. "Mac" McCluskey holds a radiation detector to his face.

Gamma rays chatter at 1,280 counts per minute.

"Most of it has gone to the bone," he said. "And I have one hot spot on the side of my face."

On Aug. 30, 1976, McCluskey, now 72, received more than 400 times the recommended lifetime maximum of radioactivity — the biggest internal dose in American nuclear industry history.

Shortly after starting his graveyard shift in the 242-Z Building at Hanford, McCluskey — a lead nuclear process operator in charge of recovering radioactive byproducts from manufacturing wastes — realized something was all wrong. Five months earlier, an extraction pipe across the room had been loaded partially with highly radioactive americium-241. Then the union went on strike. Five months later, McCluskey was standing next to the mixture of americium and resin and nitric acid when he smelled the biting fumes.

He checked the vent valve, heard a raging hiss, started for the door.

"I seen I wasn't going to make it so I made a run for it," he said. "That's when it blew.

"Knocked me clear across the room. I crawled out on my hands and knees until the other workers could get a hold of me, because I couldn't see. I was blinded. I was taken to a shower."

HAROLD R. McCLUSKEY

Nine doctors and 14 nurses worked on him throughout the night.

"Four of the doctors gave me a 50-50 chance of recovering," McCluskey said. "The others said 'no way.' "

Americium was imbedded in his face, neck and shoulders. Dr. Bryce D. Breitenstein Jr., president of the occupational health clinic known as the Hanford Environmental Health Foundation, said doctors used intensive and sometimes radical treatments to flush most of the radioactive material out of McCluskey's lungs and liver within two months of the accident.

McCluskey believes the radiation has hurt his eyesight. Breitenstein says it is difficult to say which of McCluskey's varied health problems, including cataracts and continuing heart problems, are related to the high dose.

The physician said no malignancies have developed, although latency periods can extend up to 40 years.

"We're watching him like a hawk," Breitenstein said.

For his injuries, McCluskey received a $275,000 settlement from the government and free medical care. He lives in Prosser, Wash., with his wife Ella, 72. He still receives letters addressed simply to "The Atomic Man." He remains proud of his pioneering part in the history of radiation treatment and faithful to the industry that gave him a way of life.

"There's a lot of great things that will come from nuclear," he said.

Radiation gets day in court

Dramatically different results within the last year in two radiation-related court cases show that radiation data can be like a poem — open to interpretation.

Last spring, for example, U.S. District Court Judge Bruce S. Jenkins decided that several Utah and Arizona residents had contracted cancers and died in some cases from radiation from nuclear weapons tests conducted at Nevada Test Site during the 1950s.

In ruling that the government was guilty of negligence in the way it conducted the tests, the judge produced an opinion that relied in good measure upon cancer reports from critics of the scientific mainstream: Dr. Carl J. Johnson, who has reported finding excess cancers in Denver residents near Rocky Flats nuclear complex; Karl Z. Morgan, known among admirers internationally as "the father of health physics"; Dr. John W. Gofman, a physician who is professor emeritus at the University of California at Berkeley and the author of the book "Radiation and Human Health"; and Dr. Alice M. Stewart, a University of Birmingham, England, physician who found excess cancers in the Hanford worker population.

The Jenkins decision, which the government is appealing, was the first time a major federal radiation activity was held responsible for harming civilians.

But only six months after Jenkins issued his 489-page opinion, three of the scientists relied upon by Jenkins were given a verbal thrashing by Judge Patrick F. Kelly, a U.S District Court judge in Kansas. Kelly ruled in November that the government was not at fault in a case involving alleged health damage to workers from luminious radium instrument dials.

While characterizing as "sincere and eminent" the scientists who testified on behalf of the government, Kelly dismissed Morgan as a "pathetic figure," Gofman as a man who "has never made any significant contributions to this field" and Johnson as a person who exhibited, in part of his affidavit, "incompetence at best and deception at worst."

Kelly said he rejected their testimony because he found it illogical and because they held views "which are not considered credible by the experts in the field." Hanford and industry representatives have made many photocopies of the opinion and mailed them to reporters and others with the key drubbings underlined.

Johnson, Gofman and Morgan said in interviews that they believed Kelly gave too much weight to mainstream scientists simply because they were in the mainstream. "These are the people who have been riding the great nuclear gravy train," Johnson said.

Johnson has filed a complaint and a 22-page rebuttal with the 10th U.S. Court of Appeals in Denver. He contends Kelly's opinion contained false, defamatory and biased comments.

"Well, that means that's his opinion," Kelly replied in an interview.

THE OREGONIAN
Portland, OR
MAY 20 1986

The Hanford gamble: Radiation

- What is radiation?
- Where does it come from?
- What does it do?

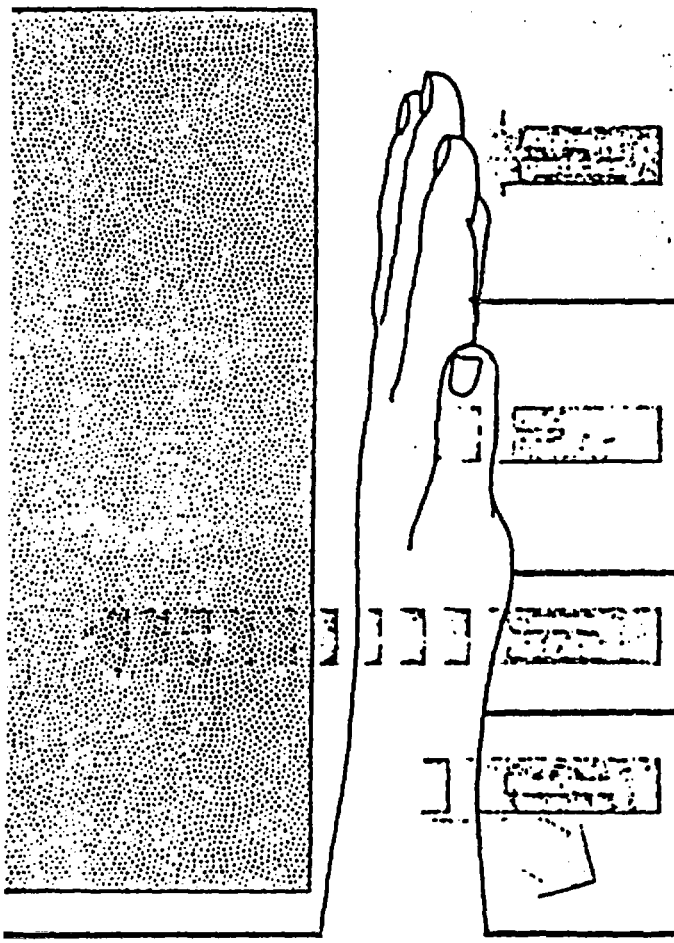
For Northwest residents, deciding what to think about activities at the Hanford Nuclear Reservation requires a background knowledge of the nuclear basics and of the potential health risks. This page provides some background.

What is radiation?

Radiation is particles or energy being thrown off by unstable atoms. Radiation is everywhere in the form of visible light, microwaves and radio waves, but the kind associated with nuclear energy and weapons is called ionizing radiation. Substances that emit ionizing radiation are said to "decay," because the process usually results in their changing into different substances — or isotopes.

In contrast to visible light and the other kinds of radiant energy, which make atoms wiggle about, ionizing radiation is so much more energetic that it jars electrons out of formerly stable atoms, changing the atoms' chemical structure. That process can injure living body tissue. Studies have shown increases in cancer with increasing radiation doses, in both humans and animals. Although their stance has proved controversial, some researchers contend that low radiation doses over long periods cause more cancer and mutations than generally has been believed.

There are five major types of ionizing radiation — alpha particles, beta particles, gamma rays, X-rays and neutrons — and they vary widely in their ability to penetrate and damage tissue:



Alpha particles consist of two protons and two neutrons together. They normally are the most energetic but least penetrating kind of radiation, because they are relatively large particles. Alpha radiation cannot pierce paper or skin, but alpha-emitting material is very harmful when inhaled, swallowed or introduced into the blood through a cut. In that case, alpha particles radiate the tissue inside the body.

Plutonium, which is produced at Hanford to make nuclear weapons, is an alpha emitter. Plutonium poses the greatest health risk when a person inhales it in an insoluble form, because the particles can lodge in the lungs and might induce lung cancer. Soluble forms can be drawn out of the system with partial success; the remainder attaches to the bone and certain organs and continues to emit radiation. There is heated disagreement over which amounts produce which effects. Some physicians say one-millionth of a gram in the lungs will cause cancer (a gram is a small fraction of an ounce); others say such effects have not been proved in humans. Both sides agree that plutonium has caused cancer in animal experiments.

These are electrons released by atoms during radioactive decay. Unlike alpha particles, beta particles can penetrate a few sheets of paper but not a book or most clothing. They also are harmful if ingested, but not nearly as damaging as alpha particles, which have much more energy and about 7,300 times greater weight.

To comprehend the relative effects of alphas and betas upon human tissue, visualize a room filled with ping-pong balls. Tossing a watermelon into the balls would approximate the impact of an alpha particle. Firing a slingshot pellet would represent the beta particle. Tritium, a hydrogen isotope that has been found in Hanford soil and Columbia River water, is a beta emitter.

Virtually the same except for their origins, portions of these high-powered packages of energy (they are not particles) can easily penetrate body tissue. Several feet of concrete will stop most gammas. Cobalt-60, widely used for cancer therapy, emits both gamma and beta radiation.

A neutron is a fundamental particle in the nucleus of atoms that has no electrical charge. About one-quarter the weight of alpha particles, neutrons can penetrate body tissue when released from the nucleus. However, practically no substances naturally decay by giving off neutrons; neutrons are emitted instead during fission, the energy-producing process in which atoms are split inside a nuclear reactor. Neutron radiation, unlike the other types of radiation, can cause previously non-radioactive materials to become radioactive themselves.

TOR
MAY 20 1985
Pg 6 of 9

Words to know

Physiology terms

Atom — Atoms are the basic component of all matter. They are the smallest part of an element having all the chemical properties of that element. A common element is oxygen. Atoms are made up of a nucleus — which contains neutrons and positively charged protons — and spinning electrons.

Molecule — A specific collection of atoms, a molecule is the smallest part of a compound having all the chemical properties of that compound. Carbon dioxide (made of atoms of carbon and oxygen) is a compound.

Cell — All plants and animals are made up of one or more cells, which are very small, complex units of living matter. Different cells perform different functions and form different organs in the body, as in blood cells, muscle cells or nerve cells.

Chromosome — Any of the microscopic rod-shaped bodies inside the cell nucleus that carry the genes, which pass on all hereditary information. If the body is to grow or repair itself, chromosomes in cells must be intact to result in exact duplication of the original cell.

DNA — Stands for deoxyribonucleic acid, the major chemical in chromosomes. Arrangements of certain molecules within the DNA form the cell's genes.

Isotope — Different atomic versions of the same element are called isotopes. The difference is in the total number of protons and neutrons in the nucleus. So, an atom of uranium-239 has four more particles in its nucleus than does uranium-235.

Radiation terms

Rad — Tells how much radiation an object or person absorbed.

Rem — Tells how much damage the radiation actually did to human tissue. Because alpha radiation and gamma radiation could result in the same dose reading of rads but have different effects, the rem measurement was created to measure the actual biological impact on human tissue. One rad of gamma is equal to one rem; one rad of alpha is equal to 10 rems. Low doses of radiation are usually expressed in thousandths of a rem, called millirems.

Curie — A curie is a measurement that tells how much radioactive material is there, but it does not distinguish between the kinds of radiation that carry different levels of destructive power. A curie simply measures the number of atoms undergoing radioactive decay in one second (37 billion, the level in one gram of radium). For example, one amount of tritium and another amount of cobalt-60 each could measure one curie because each had that same number of atoms undergoing radioactive transformation. But cobalt's gamma rays would be much more penetrating than tritium's beta particles.

THE OREGONIAN
Portland, OR
MAY 20 1985 Pg 7 of 9

An analogy

The terms "radiation," "radioactivity," "radioactive material" and "contamination" sometimes are used interchangeably, and that causes misunderstandings. One way to see the difference is to consider this analogy:

If a hot patch of tar were a radioactive material, the odor it emitted could be thought of as radiation; the intensity of the odor as the radiation level; the amount of tar as radioactivity; and contamination as what happens when someone steps in the tar and tracks it around. Just as a person is not contaminated by the odor of the tar, neither is a person contaminated by "radiation" or "radioactivity," but rather by getting the actual radioactive material on or in the body.

Where does radiation come from?

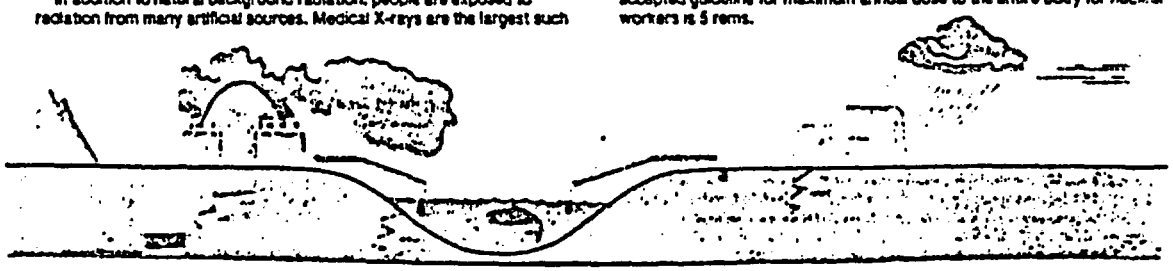
Natural background radiation is part of life on Earth. There are two sources: cosmic rays, which actually are gamma rays from the sun and other sources in outer space; and the Earth itself, which contains radioactive materials such as radium, thorium and uranium. Earth-generated radiation also is within food and human bodies, which contain cells that emit radiation from isotopes such as potassium-40 and carbon-14.

The amount of background radiation varies at different places in the world. The average yearly dose of background radiation exposure per person in the United States is 80 to 100 millirems — or thousandths of a rem — but a person who lives in Denver will receive closer to 200 millirems because of more cosmic rays at its mile-high altitude.

In addition to natural background radiation, people are exposed to radiation from many artificial sources. Medical X-rays are the largest such source, averaging about 90 millirems a year in the United States. Much lower average exposures come from the worldwide circulation of atomic weapons fallout and emissions from nuclear power plants. That brings the average U.S. radiation exposure to about 200 millirems.

Although direct connections have not been proved, many health physicists believe statistics show that background radiation alone is responsible for producing some increase in the numbers of cancers and genetic mutations.

The largest artificial exposures are routinely administered in the treatment of cancer. Over a period of four to six weeks, a tumor itself will receive a highly focused, cumulative dose of 4,000 to 6,000 rems. The accepted guideline for maximum annual dose to the entire body for nuclear workers is 5 rems.

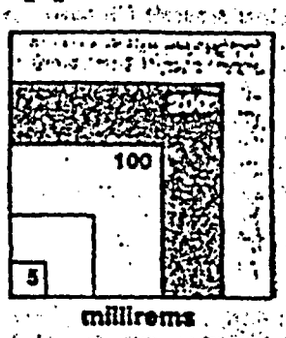


TOR

MAY 20 1985

Pg 8 of 9

Approximate radiation doses:



A round-trip transcontinental airline flight (10 hours): **5 millirems**

A single chest X-ray: **30 millirems** focused

Living in Portland for one year: **100 millirems** whole body

Living in Denver for one year: **200 millirems** whole body

A single dental X-ray: **300 millirems** focused radiation (not whole body)

Spent fuel rods

Although scientists disagree about the effects of low doses of radiation, there is no question that high doses can kill. For example, if a freak accident somehow put a person a foot away from an exposed spent fuel assembly after it had been removed from a commercial nuclear reactor after three years of use, the exposure would cause death shortly afterward. The assembly would produce heat at hundreds of degrees Fahrenheit and radiation at hundreds of thousands of rems per hour. A single whole-body radiation dose above about 3,000 rems would kill a person within two days.

SOURCES:

- "Casarett and Doull's Toxicology: The Basic Science of Poisons," edited by Louis J. Casarett and John Doull.
- "The Effects of Ionizing Radiation on Human Health," a January 1984 report by Arthur C. Upton, New York University Medical Center.
- "A Nuclear Waste Primer," 1982 revised edition, League of Women Voters Education Fund.
- David A. Stewart-Smith, health physicist with the Oregon Department of Energy and until recently with the Oregon Health Division's Radiation Control Section.
- Ronald L. Kathren, health physicist at Battelle Pacific Northwest Laboratory at Hanford.
- Dr. John W. Gofman, professor emeritus of medical physics at the University of California at Berkeley.

Compiled by Spencer Heinz /Design by Rene Eisenbart

THE OREGONIAN
Portland, OR
MAY 20 1985

What can radiation do to me?

Depending on a variety of factors — including the dose and the dose rate — radiation can damage the chromosomes that govern cell duplication in all living things. This can result in mutations, cancers, outright death of cells and other changes. An extremely high dose, above about 3,000 rems, would kill a person within two days.

Although any part of the cell can be altered by radiation, the chemical DNA in chromosomes is the most critical target because it carries the genetic code. An X-ray dose can produce dozens of lesions in the cell's DNA. Most of the lesions are repaired through the cell's DNA repair processes. However, most researchers believe that the DNA, like a broken dinner plate mended with glue, never regains its original integrity.

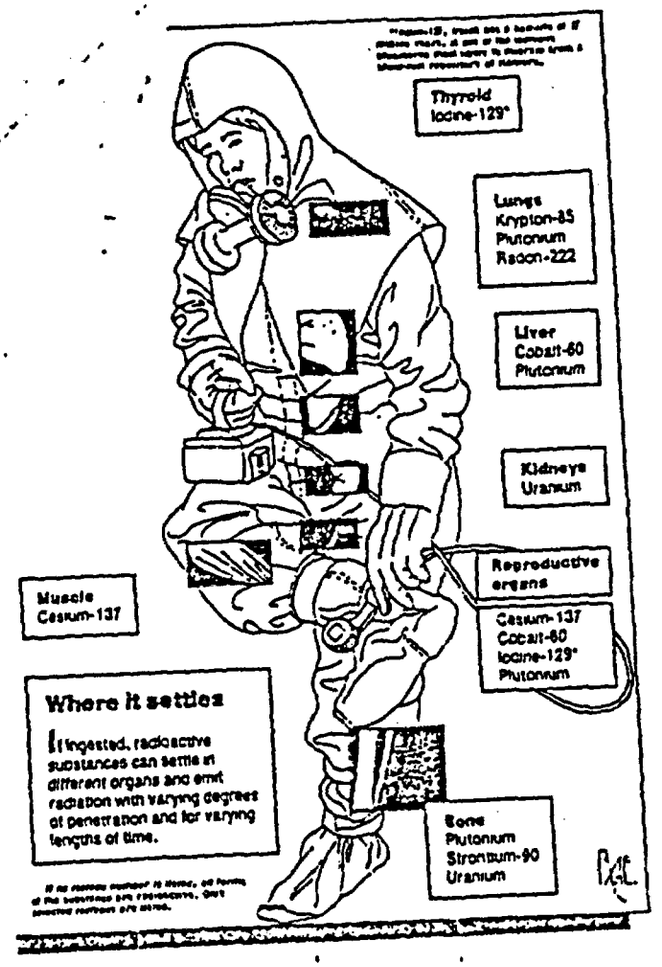
Key points to check

In situations where the health effects are not immediate and obvious, estimating damage involves knowing the dose rate, the dose, the name of the isotope (not simply the name of the material, such as plutonium, but precise type, such as plutonium-239), the kind of radiation the isotope emits, the proximity, which portion of the body was exposed, the species, age, sex and whether the organism was healthy to begin with.

Basic questions to ask in case of potential exposure:

- ✓ Was the exposure internal or external?
- ✓ If external: For how long was the person exposed? What part of the body was exposed? What isotopes were involved?
- ✓ If internal: What was the route of entry? (Different entryways can mean different health effects). What was the quantity taken into the body (in terms of microcuries, or millionths of a curie)? Was medical treatment able to remove any of the material from the body or inhibit it from attaching itself internally? Were the particles soluble? What isotopes were involved?

Knowing the isotope tells how long the substance will stay radioactive, whether its radiation is the penetrating kind and to which human organs the radioactive material will move if it was ingested through swallowing, through inhaling or through a puncture wound. For example, plutonium-239 lodges in the bone, takes 24,400 years for half of it to decay and may induce cancer five to 40 years after ingestion. Other isotopes have half-lives ranging from fractions of a second to billions of years.



THE HANFORD GAMBLE

THE OREGONIAN
Portland, OR
MAY 22 1985
C-10
Pg 1 of 5

Washington state is playing catchup as the game of siting a nuclear-fuel crypt moves toward its conclusion.

In Oregon, meanwhile, officials are trying to figure out the effects the proposal might have on the state.

Details on Page C10, in the 11th of 15 installments in The Hanford Gamble series.

THURSDAY: The activists.

The Hanford gamble: N.W. players

Search brings Hanford to Northwest states' notice

Washington takes look at complex

By FERN SHEN
of The Oregonian staff

For 40 years, while a plot of Washington land half the size of Rhode Island was soaking up hundreds of millions of gallons of radioactive chemicals and becoming the biggest-volume nuclear dump in the nation, state officials knew scarcely more than the public about what went on there.

In fact, a 1961 state law specifically barred them from setting foot on the property.

"We were guests in those days," said Donald O. Provost, special assistant to the director of the Washington Department of Ecology and a state environmental official since 1964.

"We came at their invitation and left with the little glossy packets, and that was it."

Today, largely because of a proposal to bury 77,000 tons of radioactive reactor waste there, state agencies and legislators are beginning to take their first hard look behind its Atomic Curtain.

"They cooperate fairly well until you press them," said Roger Stanley, an industrial section supervisor in the state Department of Ecology. "When you press them real hard, they have a tendency to go back to their original position, which is basically that whatever they do on this reservation is their own damn business."

Stanley's department had to threaten to sue before federal officials would let him on the reservation to investigate their waste disposal practices.

Historically, the only time Washington has paid attention to Hanford has been in response to discrete incidents, according to Provost.

Following the leak of 115,000 gallons of highly radioactive liquid defense wastes from an underground tank in 1973, the state formed a task force, but "not much came of it," Provost said.

The 1982 Nuclear Waste Policy Act, however, beamed a spotlight on the closed world of Hanford.

"It isn't just me or the Department of Ecology — the level of the state's interest in Hanford has just gone way up," Stanley said. "A lot of it has to do with the act."

The act required that potential host states be given information on the dump program and money to monitor Energy Department activities. Also, the prospect of Washington's accepting some of the nation's spent-fuel rods prompted state officials to consider Hanford's other radioactive waste.

"People began waking up to the fact that Washington has already reached its radioactive burden," said Rep. Dick Nelson, a Democrat from Seattle.

Another factor that drew attention to Hanford was the 1983 restart of PUREX, the reservation's plutonium-uranium extraction plant where plutonium is extracted for warheads.

But critics say state officials have protested too little, too late about the repository proposal.

"Our reputation as pushovers is not going to die overnight," said Ruth Weiner, assistant professor of environmental studies at Western Washington University in Bellingham and a longtime critic of Hanford.

When the Department of Energy released a December 1984 report that named Hanford one of the top three sites in the nation, along with Yucca Mountain in Nevada and Deaf Smith County in Texas, outgoing Gov. John Spellman was subdued compared to the reactions of other governors. News reports at the time show no major announcements by the governor on the repository proposal.

(Spellman, who now works for a Seattle law firm, did not return at least four phone calls to ask about his reaction at the time.)

In contrast, Texas Gov. Mark White Jr. thundered that Deaf Smith, a hero in the Texas revolution from Mexico, "would roll over in his grave" before letting his namesake county become a nuclear waste dump.

The report naming Texas a top site, snapped Texas Agriculture Commissioner Jim Hightower, was written by consultants who didn't want to visit

TOR
MAY 22 1985
Pg 2 of 5

the area "and get manure on their Guccis."

Utah Gov. Norman H. Bangerter, whose state has a site among the top five, announced that Utah "refuses to cooperate" with the Energy Department, saying that the data were insufficent, that politics seemed to be skewing the process and that studies didn't explain how a repository could be put within a mile of a national park.

After he took office in January, Gov. Booth Gardner adopted a low-key approach. On Feb. 8, three weeks after taking office, Gardner asked the federal government to extend the comment period on the draft environmental assessment. When that was denied, he criticized the response as "irresponsible."

With Gardner's support, the state filed suit in March against the Energy Department, charging that its siting guidelines are vague and ignore transportation and defense waste issues. It also filed a brief in support of a Nevada suit to get more money to monitor repository siting activities through the 1982 law that set up the program.

Later in the spring, Gardner toured the repository test tunnel at Hanford and said he "was not overly concerned about bias" in the siting process. The important thing was to "make sure that all the information that's brought out is available to everyone," he said.

Legislators, for their part, until recently had been unaware of activities at Hanford, critics say, largely because they were intimidated by the scientific sophistication of Hanford officials.

"The average legislator doesn't know a curie from an atom," said Margaret Hurley, a former Spokane Democratic state senator who became known as one of the reservation's sharpest critics.

During 1984, the 15-member Nuclear Waste Board, which consists of state agency department heads and non-voting legislators, focused on signing an agreement with the federal government that would clarify state and federal roles in the waste site search.

But the so-called consultation and cooperation agreements were shelved when the environmental assessments were released in December.

"All of a sudden, all of the urgency was gone," said Rep. Nelson. "I think the prior administration was more interested in signing than the current one is."

Two sticking points in the those discussions, however, remain stuck.

Chief among them is the status of the leaking tanks of radioactive defense wastes, which federal officials have been promising to repair for decades.

Another pending question is the Energy Department's refusal to determine the economic and environmental costs in the event of a severe accident and its refusal to accept liability above the limit set by the 1957 Price-Anderson Act.

The law provides that the owners of a commercial nuclear reactor would have to pay no more than $600 million in damages in the event of an accident. Rep. Sid Morrison, R-Wash., has introduced a bill in Congress to make the federal government fully liable.

As the likelihood grows that the Hanford site will undergo $370 million worth of intense study, state legislators mobilized this year to approve laws designed to give the state leverage over Hanford:

- A bill to spend nearly $132,000 a year in state revenue for environmental monitoring of Hanford. Currently, the only money used by the state specifically to monitor Hanford is $87,000 in federal money received as part of the repository siting process. That compares to a $250,000 budget in Colorado to take samples around the Rocky Flats weapons plant near Denver.

Although the bill would permit the state to go on the reservation, the Energy Department has indicated it may invoke national security to prohibit certain measurements because the data would be a clue to plutonium output, a classified number.

"I asked about monitoring on PUREX's main (emissions) stack," said Terry R. Strong, head of the radiation control program at the state Department of Social and Health Services. "They said, 'Well, it depends. . . ."

- A bill that braces the state for increased activity to study the repository by taxing it. The bill would raise $75 million per year by charging the federal government for activities connected with high-level radioactive waste. However, Gardner has not signed that bill yet.

Michael J. Lawrence, Richland operations manager for the Department of Energy, has said he would ask the Justice Department to consider challenging it on constitutional grounds.

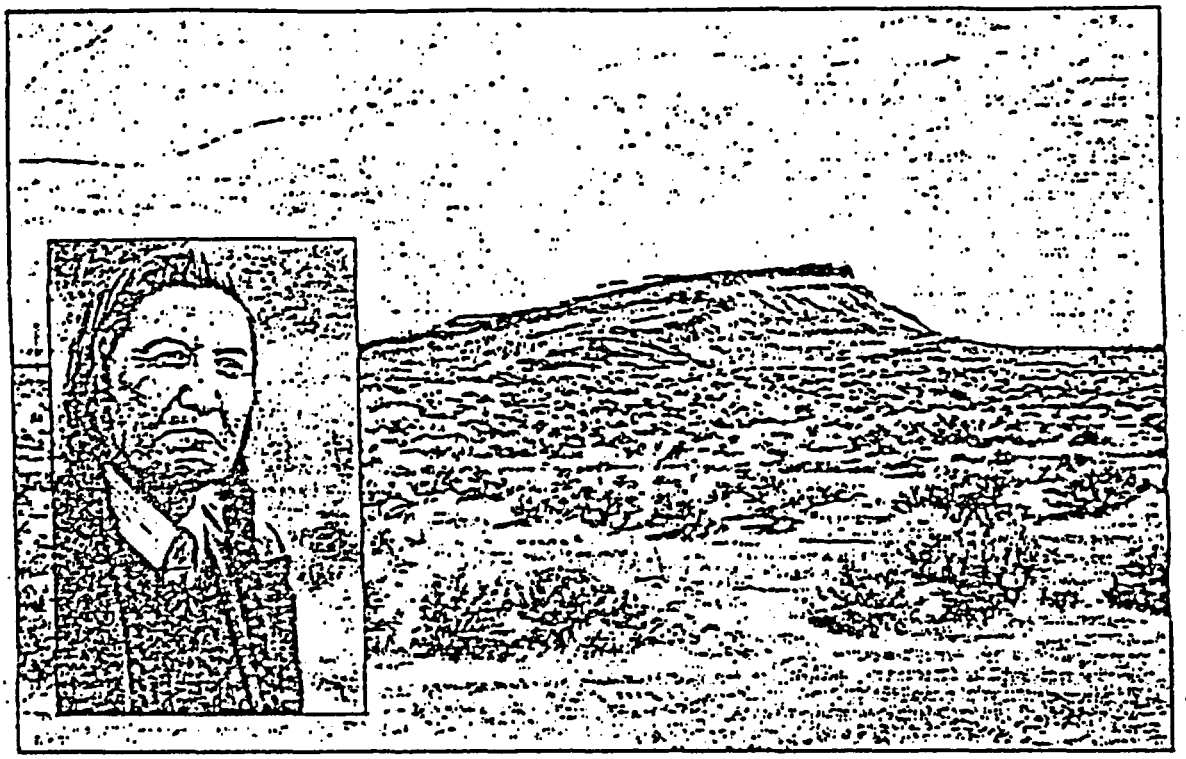
- A bill that directs the state Nuclear Waste Board to study the impact of repository-related transportation on the state and to come up with alternative routes.

Washington state officials say they don't feel intimidated as they study the spent-fuel repository.

"We're going to be careful and we're going to be thorough and we're not going to be stampeded," said William Brewer, technical director for Washington Department of Ecology's High-Level Radioactive Waste Management office.

NEXT: Nuclear boosters and opponents.

THE OREGONIAN
Portland, OR
MAY 22 1985 Pg 3 of 5



The Oregonian

SACRED MOUNTAIN — Russell Jim says going to the Yakimas' sacred site of Gable Mountain means red tape, so Indians stay away.

Yakima tribes fight repository proposal

TOPPENISH, Wash. — Slapped daily with the cultural contradictions of the Hubba Hubba Lounge and the Pow Wow Emporium, tribal leaders here made an ethnic sanctuary of the Yakima Cultural Center.

Visitors can read the old myths, listen to recordings of the sacred birds and trace tribal births, deaths and other events in a ball of string marked with knots and beads — "a time ball."

But there would be no refuge, the Yakimas fear, from the government's proposal to bury spent nuclear fuel on the Hanford Nuclear Reservation, 13 miles from the Indians' reservation and four miles from the river they consider a cultural lifeline.

Contamination of the land would not be just another bead on the time ball, they say, it would mean genocide.

"What if there is an accident, and we are evacuated from here?" a sobbing Yakima woman asked Benjamin C. Rusche, director of the national Office of Civilian Radioactive Waste Management, during a breakfast meeting at the cultural center during the spring. "If we lose our land we are nothing. Finished."

"We are non-evacuable — we are created here, we will die here," said Russell Jim, manager of the Yakimas' program for nuclear waste studies. "The bones of our ancestors are in this land."

Perhaps because they are closer to the proposed dump than the two other tribal groups the government recognizes as "affected" by the siting process, the Yakima tribes have fought the proposal the most vigorously. (The others are the Umatilla Confederated Tribes in northeastern Oregon and Nez Perce in Idaho.) The 7,000-member Yakima Nation enlisted geologists, hydrologists and Washington, D.C., attorneys to do a detailed dissection of the December environmental assessment that names Hanford among the top three sites in the nation.

The U.S. Department of Energy's evaluations of the environmental effects of a repository, the tribes argue, ignores the heavy cultural, religious and emotional stake Indians have in the land near Hanford.

When they flourished at the confluence of the Snake, Yakima and Columbia Rivers at least 15,000 years ago, the Yakimas presided over a domain a quarter of the size of what is now Washington state. In return for ceding 10.5 million acres to the federal government in 1855, they were given a reservation of 1.5 million acres, with perpetual rights to hunt, fish and forage on the ceded area.

When the government invoked the War Powers Act and seized 570 square miles of the ceded land in 1943 for what became the Hanford Nuclear Reservation, it excluded Indians from an area of special significance to them.

"The mainstem of society has declared that that area is a wasteland," said Jim. "Not to us."

The low land around the Columbia was the tribe's annual wintering ground. Gable Mountain, in the northeastern section of the Hanford complex, was the sacred spot where the First Man and First Woman appeared and where Indian children coming of age went on spirit quests. Now, tunnels have been bored into Gable by government workers studying the basalt rock's suitability as a receptacle for lethal waste.

The Indians don't go there much anymore.

"It's a lot of trouble," said Jim. "

have to clear it with the Energy Department, give them my Social Security number, all that."

Beside attacking the dump proposal on its merits, tribal attorneys are looking at laws and treaties that might give them more leverage over the selection process. Although they generally have the same rights as states — to be notified of developments in the program and to get federal money for independent studies — Energy officials say the tribes have no right to veto the decision, as states do.

If they cannot convince the Energy Department or the courts that old treaties should give them veto rights, the Yakimas have considered invoking their 1978 resolution to prohibit the transportation of nuclear wastes through the reservation. They concede that the tactic may be a tenuous one.

"Our wars are still continuing in the halls of Congress, in the Supreme Court, in the state legislatures," said Allan Slickpoo, an executive member of the Tribal Council of the Nez Perce. "Now we enter a new era of conflict — the conflict over nuclear waste."

Oregonians seek rights in selection

With the Columbia River flowing past 313 miles of common border between Washington and Oregon, radioactive contamination seeping into the river would threaten Oregonians as well as Washington residents.

With Hanford dump wastes expected to travel over seven times more Oregon miles than Washington miles, truck accidents may threaten Oregon even more than its northern neighbor.

Yet, because the waste is not on Oregon land, the state has no right — as Washington does — to federal money to study the proposal, and no right to veto the repository.

"Radionuclides will not stop at the border in the middle of the river," Barbara McLaughlin of Cannon Beach told officials of the U.S. Department of Energy at a March hearing in Portland.

Michael J. Lawrence, the department's operations manager in Richland, Wash., maintains that granting legal standing to adjacent states would get out of hand.

"You have to wonder where you draw the line," Lawrence said, responding to a bill introduced by Rep. Jim Weaver, D-Ore., that would amend the 1982 Nuclear Waste Policy Act to include Oregon. "How many states would have veto power then? If it was just bordering states, what about Idaho?"

William T. Dixon, the man designated by Gov. Vic Atiyeh as Oregon's point man on the Hanford repository issue and director of the siting division of the state Energy Department, agreed with federal officials that the state should stop trying to get legal standing.

Dixon's attitude has drawn fire from local critics, who say the state has been too weak a voice in the repository wranglings.

"It's really outrageous, but as a state, we are adding nothing to the debate," said Joanne Oleksiak, director of the Hanford Clearinghouse, a non-profit group that has criticized the proposal.

It wasn't until December, when Hanford was tentatively named one of the top three sites in the nation, that Oregon legislators and administrative officials mobilized to learn about the proposal and involve the state.

The Hanford Repository Review Committee, a collection of state officials that had not met since its creation in 1983, began meeting after December, Dixon said. It has met three or four times since then, he said.

The group will study the repository's impact on Oregon and how the state should respond. It also is studying the impact of radioactive shipments of decommissioned reactor parts that the Energy Department plans to barge up the Columbia.

Atiyeh has been criticized by Rep. Wayne Fawbush, D-Hood River, and other legislators, for failing to take a vigorous stand or to comment when the environmental assessments were released in December.

Dixon argued that it wasn't necessary for Oregon to get involved any earlier.

"We didn't know if we were going to be in the top three until December," he said. "This issue is going to evolve over a lot of years."

The governors of the two states recently agreed tentatively that Washington would share some of its federal money with Oregon.

Oregon would like $100,000 to pay for two technicians to help the committee assess the repository's effect on the state via the Columbia River and transportation of spent fuel to the proposed repository.

Some argue that radioactive contamination of the Columbia would harm Oregon even more than it would Washington because Oregon's major population center is on the river. The Portland metropolitan area, with 1.07 million people, is the home of 40 percent of Oregon's population.

TOR
MAY 22 1986
Pg 4 of 5

Seattle, Washington's major population center, is about 150 air miles from the repository site, in the northwest corner of the state, away from prevailing winds and with no water connection to the site.

THE OREGONIAN
Portland, OR
MAY 22 1985

Washington research analyst battles dismissal for 'anti-nuclear bias'

Nuclear waste was Eleanore Price's specialty, but nuclear politics may have been her undoing.

In 13 years of advising Washington legislators on radioactive waste, the research analyst never was given a bad performance review.

But Price got a pink slip in June 1983 after making public an internal memorandum dated April 26, 1983, that strongly suggested bias among the government officials studying the Hanford Nuclear Reservation's suitability as a site for disposing of spent nuclear fuel rods.

In the memo, Raul Deju — then manager of the U.S. Department of Energy's Basalt Waste Isolation Project — told his staff that his "goal" was to make Hanford "the first repository for long-term storage of nuclear waste." When Sen. Al Williams, D-Seattle, read the document at a May 1983 congressional hearing, Hanford critics seized upon it as an example of the promotional approach they said Rockwell took toward studying the site.

Deju left his position shortly afterward, taking another Energy Department job.

Price, 55, was fired the next month for poor performance and anti-nuclear bias, said Edward D. Seeburger, staff director for Senate committee staff services. Price is challenging the firing in Washington Superior Court, in a suit that names Seeburger, Williams, the Tri-City Herald, Sen. Max Benitz, R-Prosser, and others as defendants. She seeks back pay, reinstatement and an undetermined amount of damages for defamation of character.

"It was a total frame-up," Price said. "I did my job too well — I was telling things people didn't want to hear."

The Deju memo and research reports that were seen as reflecting badly on Hanford, Price said, irked Tri-Cities legislators, who pressured Seeburger to have her fired.

Seeburger, the supervisor who fired Price from her job on the Senate Energy and Utilities Committee, said she had been warned verbally that her work was "not objective."

"Bias was a factor — she was perceived by everyone at work as anti-nuclear," Seeburger said. "Whether or not she is biased, if she was perceived that way, then there's a general problem," he said.

Price denied that anyone had ever warned her that she could lose her job because of bias, and she defended her research and writing.

Among the criticisms she passed on to senators were allegations of technical deficiencies in the Site Characterization Report, the document providing the scientific rationale for further study of the Hanford site as a spent-fuel repository. The U.S. Geological Survey and the U.S. Nuclear Regulatory Commission both released scathing reports of the document, and Price summarized the criticism.

Price's supervisors deny that the Deju memo was a factor in Price's dismissal, but they concede that other incidents played a role.

In January 1983, Price wrote a memo summarizing legislative testimony given to the committee by Jim Worthington, executive secretary of the Southeast Washington Building Trades Council and a member of the advisory council to the Governor's Task Force on High-Level Waste. He told legislators his group regarded high-level nuclear work as safe and as "another industry for the state of Washington," according to the transcript.

Price's memo added that Worthington's "objectivity has come into question by some members of the environmental community."

Price's memo angered at least two Tri-Cities legislators — Benitz and Rep. Ray Isaacson, R-Richland, who works for Rockwell Hanford Operations.

"If Senate Energy Committee chairman Al Williams won't straighten out Mrs. Price's bias," Benitz said, he would "go to the Democratic leadership," according to a Feb. 10, 1984, column by Tri-City Herald columnist Jack Briggs.

"She was fired for lack of objectivity," Benitz said recently. "Her reports are biased toward the anti-nuclear."

When Seeburger told Price that she was fired in June 1983 — and wrote up the dismissal in a formal letter — the only reason he gave was an end-of-session "reduction in work force," Price said.

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Seeburger also noted that she was "perceived as having taken a position as an anti-nuke."

Whether or not Price, who now works for the State Department of Social and Health Services, wins the suit, she said she felt vindicated.

Criticism of the advisory council — seven of nine members were from the Tri-Cities — became so intense that then-Gov. John Spellman disbanded it and reorganized state panels dealing with [illegible] waste.

THE HANFORD GAMBLE

THE OREGONIAN
Portland, OR
MAY 22 1986
C-10
Pg 1 of 5

Washington state is playing catchup as the game of siting a nuclear-fuel crypt moves toward its conclusion.

In Oregon, meanwhile, officials are trying to figure out the effects the proposal might have on the state.

Details on Page C10, in the 11th of 15 installments in The Hanford Gamble series.

THURSDAY: The activists.

The Hanford gamble: N.W. players

Search brings Hanford to Northwest states' notice

Washington takes look at complex

By FERN SHEN
of The Oregonian staff

For 40 years, while a plot of Washington land half the size of Rhode Island was soaking up hundreds of millions of gallons of radioactive chemicals and becoming the biggest-volume nuclear dump in the nation, state officials knew scarcely more than the public about what went on there.

In fact, a 1961 state law specifically barred them from setting foot on the property.

"We were guests in those days," said Donald O. Provost, special assistant to the director of the Washington Department of Ecology and a state environmental official since 1964.

"We came at their invitation and left with the little glossy packets, and that was it."

Today, largely because of a proposal to bury 77,000 tons of radioactive reactor waste there, state agencies and legislators are beginning to take their first hard look behind its Atomic Curtain.

"They cooperate fairly well until you press them," said Roger Stanley, an industrial section supervisor in the state Department of Ecology. "When you press them real hard, they have a tendency to go back to their original position, which is basically that whatever they do on this reservation is their own damn business."

Stanley's department had to threaten to sue before federal officials would let him on the reservation to investigate their waste disposal practices.

Historically, the only time Washington has paid attention to Hanford has been in response to discrete incidents, according to Provost.

Following the leak of 115,000 gallons of highly radioactive liquid defense wastes from an underground tank in 1973, the state formed a task force, but "not much came of it," Provost said.

The 1982 Nuclear Waste Policy Act, however, beamed a spotlight on the closed world of Hanford.

"It isn't just me or the Department of Ecology — the level of the state's interest in Hanford has just gone way up," Stanley said. "A lot of it has to do with the act."

The act required that potential host states be given information on the dump program and money to monitor Energy Department activities. Also, the prospect of Washington's accepting some of the nation's spent-fuel rods prompted state officials to consider Hanford's other radioactive waste.

"People began waking up to the fact that Washington has already reached its radioactive burden," said Rep. Dick Nelson, a Democrat from Seattle.

Another factor that drew attention to Hanford was the 1983 restart of PUREX, the reservation's plutonium-uranium extraction plant where plutonium is extracted for warheads.

But critics say state officials have protested too little, too late about the repository proposal.

"Our reputation as pushovers is not going to die overnight," said Ruth Weiner, assistant professor of environmental studies at Western Washington University in Bellingham and a longtime critic of Hanford.

When the Department of Energy released a December 1984 report that named Hanford one of the top three sites in the nation, along with Yucca Mountain in Nevada and Deaf Smith County in Texas, outgoing Gov. John Spellman was subdued compared to the reactions of other governors. News reports at the time show no major announcements by the governor on the repository proposal.

(Spellman, who now works for a Seattle law firm, did not return at least four phone calls to ask about his reaction at the time.)

In contrast, Texas Gov. Mark White Jr. thundered that Deaf Smith, a hero in the Texas revolution from Mexico, "would roll over in his grave" before letting his namesake county become a nuclear waste dump.

The report naming Texas a top site, snapped Texas Agriculture Commissioner Jim Hightower, was written by consultants who didn't want to visit

TOR
MAY 22 1985
Pg 2 of 5

the area "and get manure on their Guccis."

Utah Gov. Norman H. Bangerter, whose state has a site among the top five, announced that Utah "refuses to cooperate" with the Energy Department, saying that the data were insufficent, that politics seemed to be skewing the process and that studies didn't explain how a repository could be put within a mile of a national park.

After he took office in January, Gov. Booth Gardner adopted a low-key approach. On Feb. 8, three weeks after taking office, Gardner asked the federal government to extend the comment period on the draft environmental assessment. When that was denied, he criticized the response as "irresponsible."

With Gardner's support, the state filed suit in March against the Energy Department, charging that its siting guidelines are vague and ignore transportation and defense waste issues. It also filed a brief in support of a Nevada suit to get more money to monitor repository siting activities through the 1982 law that set up the program.

Later in the spring, Gardner toured the repository test tunnel at Hanford and said he "was not overly concerned about bias" in the siting process. The important thing was to "make sure that all the information that's brought out is available to everyone," he said.

Legislators, for their part, until recently had been unaware of activities at Hanford, critics say, largely because they were intimidated by the scientific sophistication of Hanford officials.

"The average legislator doesn't know a curie from an atom," said Margaret Hurley, a former Spokane Democratic state senator who became known as one of the reservation's sharpest critics.

During 1984, the 15-member Nuclear Waste Board, which consists of state agency department heads and non-voting legislators, focused on signing an agreement with the federal government that would clarify state and federal roles in the waste site search.

But the so-called consultation and cooperation agreements were shelved when the environmental assessments were released in December.

"All of a sudden, all of the urgency was gone," said Rep. Nelson. "I think the prior administration was more interested in signing than the current one is."

Two sticking points in the those discussions, however, remain stuck.

Chief among them is the status of the leaking tanks of radioactive defense wastes, which federal officials have been promising to repair for decades.

Another pending question is the Energy Department's refusal to determine the economic and environmental costs in the event of a severe accident and its refusal to accept liability above the limit set by the 1957 Price-Anderson Act.

The law provides that the owners of a commercial nuclear reactor would have to pay no more than $600 million in damages in the event of an accident. Rep. Sid Morrison, R-Wash., has introduced a bill in Congress to make the federal government fully liable.

As the likelihood grows that the Hanford site will undergo $870 million worth of intense study, state legislators mobilized this year to approve laws designed to give the state leverage over Hanford:

- A bill to spend nearly $132,000 a year in state revenue for environmental monitoring of Hanford. Currently, the only money used by the state specifically to monitor Hanford is $87,000 in federal money received as part of the repository siting process. That compares to a $250,000 budget in Colorado to take samples around the Rocky Flats weapons plant near Denver.

Although the bill would permit the state to go on the reservation, the Energy Department has indicated it may invoke national security to prohibit certain measurements because the data would be a clue to plutonium output, a classified number.

"I asked about monitoring on PUREX's main (emissions) stack," said Terry R. Strong, head of the radiation control program at the state Department of Social and Health Services. "They said, 'Well, it depends. . . ."

- A bill that braces the state for increased activity to study the repository by taxing it. The bill would raise $75 million per year by charging the federal government for activities connected with high-level radioactive waste. However, Gardner has not signed that bill yet.

Michael J. Lawrence, Richland operations manager for the Department of Energy, has said he would ask the Justice Department to consider challenging it on constitutional grounds.

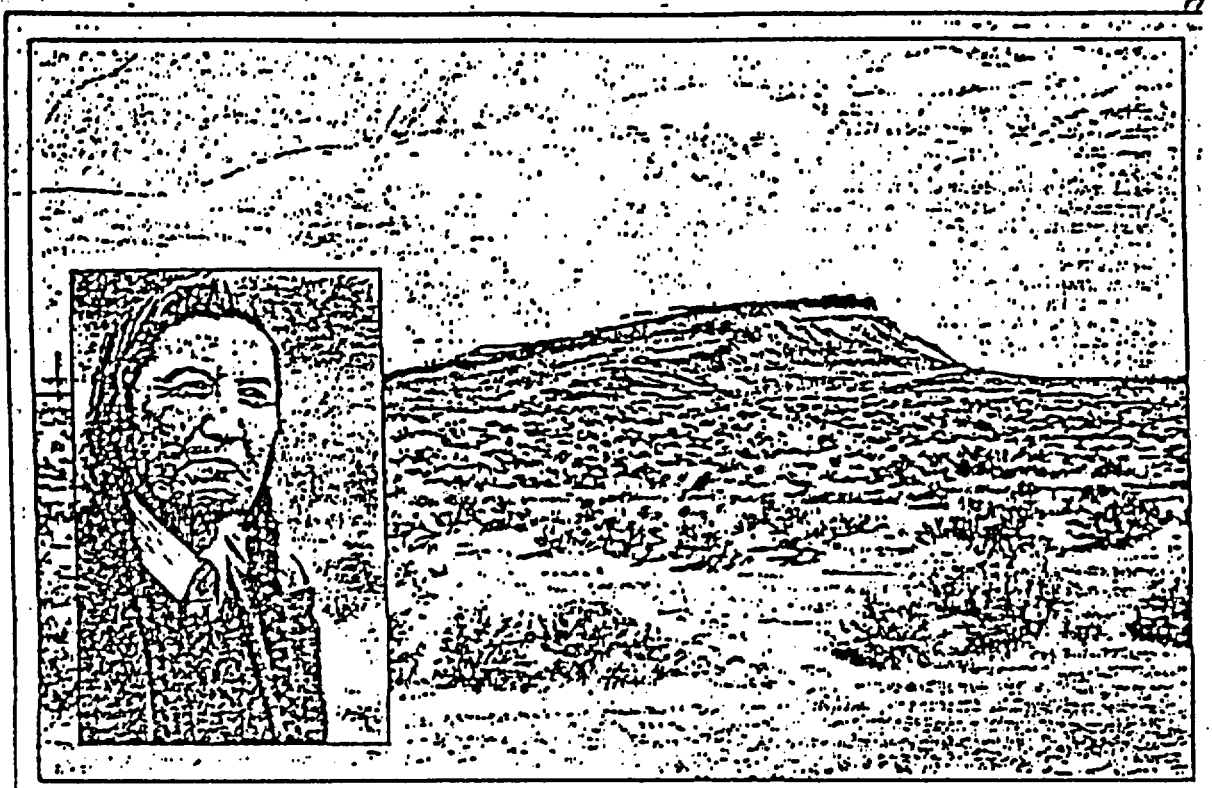
- A bill that directs the state Nuclear Waste Board to study the impact of repository-related transportation on the state and to come up with alternative routes.

Washington state officials say they don't feel intimidated as they study the spent-fuel repository.

"We're going to be careful and we're going to be thorough and we're not going to be stampeded," said William Brewer, technical director for Washington Department of Ecology's High-Level Radioactive Waste Management office.

NEXT: Nuclear boosters and opponents.

THE OREGONIAN
Portland, OR
MAY 22 1985



The Oregonian

SACRED MOUNTAIN — Russell Jim says going to the Yakimas' sacred site of Gable Mountain means red tape, so Indians stay away.

Yakima tribes fight repository proposal

TOPPENISH, Wash. — Slapped daily with the cultural contradictions of the Hubba Hubba Lounge and the Pow Wow Emporium, tribal leaders here made an ethnic sanctuary of the Yakima Cultural Center.

Visitors can read the old myths, listen to recordings of the sacred birds and trace tribal births, deaths and other events in a ball of string marked with knots and beads — "a time ball."

But there would be no refuge, the Yakimas fear, from the government's proposal to bury spent nuclear fuel on the Hanford Nuclear Reservation, 13 miles from the Indians' reservation and four miles from the river they consider a cultural lifeline.

Contamination of the land would not be just another bead on the time ball, they say, it would mean genocide.

"What if there is an accident, and we are evacuated from here?" a sobbing Yakima woman asked Benjamin C. Rusche, director of the national Office of Civilian Radioactive Waste Management, during a breakfast meeting at the cultural center during the spring. "If we lose our land we are nothing. Finished."

"We are non-evacuable — we are created here, we will die here," said Russell Jim, manager of the Yakimas' program for nuclear waste studies. "The bones of our ancestors are in this land."

Perhaps because they are closer to the proposed dump than the two other tribal groups the government recognizes as "affected" by the siting process, the Yakima tribes have fought the proposal the most vigorously. (The others are the Umatilla Confederated Tribes in northeastern Oregon and Nez Perce in Idaho.) The 7,000-member Yakima Nation enlisted geologists, hydrologists and Washington, D.C., attorneys to do a detailed dissection of the December environmental assessment that names Hanford among the top three sites in the nation.

The U.S. Department of Energy's evaluations of the environmental effects of a repository, the tribes argue, ignores the heavy cultural, religious and emotional stake Indians have in the land near Hanford.

When they flourished at the confluence of the Snake, Yakima and Columbia Rivers at least 15,000 years ago, the Yakimas presided over a domain a quarter of the size of what is now Washington state. In return for ceding 10.5 million acres to the federal government in 1855, they were given a reservation of 1.5 million acres, with perpetual rights to hunt, fish and forage on the ceded area.

When the government invoked the War Powers Act and seized 570 square miles of the ceded land in 1943 for what became the Hanford Nuclear Reservation, it excluded Indians from an area of special significance to them.

"The mainstem of society has declared that that area is a wasteland," said Jim. "Not to us."

The low land around the Columbia was the tribe's annual wintering ground. Gable Mountain, in the northeastern section of the Hanford complex, was the sacred spot where the First Man and First Woman appeared and where Indian children coming of age went on spirit quests. Now, tunnels have been bored into Gable by government workers studying the basalt rock's suitability as a receptacle for lethal waste.

The Indians don't go there much anymore.

"It's a lot of trouble," said Jim. "

TOR
MAY 22 1986
pg 4 of 6

have to clear it with the Energy Department, give them my Social Security number, all that."

Beside attacking the dump proposal on its merits, tribal attorneys are looking at laws and treaties that might give them more leverage over the selection process. Although they generally have the same rights as states — to be notified of developments in the program and to get federal money for independent studies — Energy officials say the tribes have no right to veto the decision, as states do.

If they cannot convince the Energy Department or the courts that old treaties should give them veto rights, the Yakimas have considered invoking their 1978 resolution to prohibit the transportation of nuclear wastes through the reservation. They concede that the tactic may be a tenuous one.

"Our wars are still continuing in the halls of Congress, in the Supreme Court, in the state legislatures," said Allan Slickpoo, an executive member of the Tribal Council of the Nez Perce. "Now we enter a new era of conflict — the conflict over nuclear waste."

Oregonians seek rights in selection

With the Columbia River flowing past 313 miles of common border between Washington and Oregon, radioactive contamination seeping into the river would threaten Oregonians as well as Washington residents.

With Hanford dump wastes expected to travel over seven times more Oregon miles than Washington miles, truck accidents may threaten Oregon even more than its northern neighbor.

Yet, because the waste is not on Oregon land, the state has no right — as Washington does — to federal money to study the proposal, and no right to veto the repository.

"Radionuclides will not stop at the border in the middle of the river," Barbara McLaughlin of Cannon Beach told officials of the U.S. Department of Energy at a March hearing in Portland.

Michael J. Lawrence, the department's operations manager in Richland, Wash., maintains that granting legal standing to adjacent states would get out of hand.

"You have to wonder where you draw the line," Lawrence said, responding to a bill introduced by Rep. Jim Weaver, D-Ore., that would amend the 1982 Nuclear Waste Policy Act to include Oregon. "How many states would have veto power then? If it was just bordering states, what about Idaho?"

William T. Dixon, the man designated by Gov. Vic Atiyeh as Oregon's point man on the Hanford repository issue and director of the siting division of the state Energy Department, agreed with federal officials that the state should stop trying to get legal standing.

Dixon's attitude has drawn fire from local critics, who say the state has been too weak a voice in the repository wranglings.

"It's really outrageous, but as a state, we are adding nothing to the debate," said Joanne Oleksiak, director of the Hanford Clearinghouse, a non-profit group that has criticized the proposal.

It wasn't until December, when Hanford was tentatively named one of the top three sites in the nation, that Oregon legislators and administrative officials mobilized to learn about the proposal and involve the state.

The Hanford Repository Review Committee, a collection of state officials that had not met since its creation in 1983, began meeting after December, Dixon said. It has met three or four times since then, he said.

The group will study the repository's impact on Oregon and how the state should respond. It also is studying the impact of radioactive shipments of decommissioned reactor parts that the Energy Department plans to barge up the Columbia.

Atiyeh has been criticized by Rep. Wayne Fawbush, D-Hood River, and other legislators, for failing to take a vigorous stand or to comment when the environmental assessments were released in December.

Dixon argued that it wasn't necessary for Oregon to get involved any earlier.

"We didn't know if we were going to be in the top three until December," he said. "This issue is going to evolve over a lot of years."

The governors of the two states recently agreed tentatively that Washington would share some of its federal money with Oregon.

Oregon would like $100,000 to pay for two technicians to help the committee assess the repository's effect on the state via the Columbia River and transportation of spent fuel to the proposed repository.

Some argue that radioactive contamination of the Columbia would harm Oregon even more than it would Washington because Oregon's major population center is on the river. The Portland metropolitan area, with 1.07 million people, is the home of 40 percent of Oregon's population.

Seattle, Washington's major population center, is about 150 air miles from the repository site, in the northwest corner of the state, away from prevailing winds and with no water connection to the site.

THE OREGONIAN
Portland, OR
MAY 22 1985

Washington research analyst battles dismissal for 'anti-nuclear bias'

Nuclear waste was Eleanore Price's specialty, but nuclear politics may have been her undoing.

In 13 years of advising Washington legislators on radioactive waste, the research analyst never was given a bad performance review.

But Price got a pink slip in June 1983 after making public an internal memorandum dated April 26, 1983, that strongly suggested bias among the government officials studying the Hanford Nuclear Reservation's suitability as a site for disposing of spent nuclear fuel rods.

In the memo, Raul Deju — then manager of the U.S. Department of Energy's Basalt Waste Isolation Project — told his staff that his "goal" was to make Hanford "the first repository for long-term storage of nuclear waste." When Sen. Al Williams, D-Seattle, read the document at a May 1983 congressional hearing, Hanford critics seized upon it as an example of the promotional approach they said Rockwell took toward studying the site.

Deju left his position shortly afterward, taking another Energy Department job.

Price, 55, was fired the next month for poor performance and anti-nuclear bias, said Edward D. Seeburger, staff director for Senate committee staff services. Price is challenging the firing in Washington Superior Court, in a suit that names Seeburger, Williams, the Tri-City Herald, Sen. Max Benitz, R-Prosser, and others as defendants. She seeks back pay, reinstatement and an undetermined amount of damages for defamation of character.

"It was a total frame-up," Price said. "I did my job too well — I was telling things people didn't want to hear."

The Deju memo and research reports that were seen as reflecting badly on Hanford, Price said, irked Tri-Cities legislators, who pressured Seeburger to have her fired.

Seeburger, the supervisor who fired Price from her job on the Senate Energy and Utilities Committee, said she had been warned verbally that her work was "not objective."

"Bias was a factor — she was perceived by everyone at work as anti-nuclear," Seeburger said. "Whether or not she is biased, if she was perceived that way, then there's a general problem," he said.

Price denied that anyone had ever warned her that she could lose her job because of bias, and she defended her research and writing.

Among the criticisms she passed on to senators were allegations of technical deficiencies in the Site Characterization Report, the document providing the scientific rationale for further study of the Hanford site as a spent-fuel repository. The U.S. Geological Survey and the U.S. Nuclear Regulatory Commission both released scathing reports of the document, and Price summarized the criticism.

Price's supervisors deny that the Deju memo was a factor in Price's dismissal, but they concede that other incidents played a role.

In January 1983, Price wrote a memo summarizing legislative testimony given to the committee by Jim Worthington, executive secretary of the Southeast Washington Building Trades Council and a member of the advisory council to the Governor's Task Force on High-Level Waste. He told legislators his group regarded high-level nuclear work as safe and as "another industry for the state of Washington," according to the transcript.

Price's memo added that Worthington's "objectivity has come into question by some members of the environmental community."

Price's memo angered at least two Tri-Cities legislators — Benitz and Rep. Ray Isaacson, R-Richland, who works for Rockwell Hanford Operations.

"If Senate Energy Committee chairman Al Williams won't straighten out Mrs. Price's bias," Benitz said, he would "go to the Democratic leadership," according to a Feb. 10, 1984, column by Tri-City Herald columnist Jack Briggs.

"She was fired for lack of objectivity," Benitz said recently. "Her reports are biased toward the anti-nuclear."

When Seeburger told Price that she was fired in June 1983 — and wrote up the dismissal in a formal letter — the only reason he gave was an end-of-session "reduction in work force," Price said.

Later, however, in a fact-finding conference held by the state Human Rights Commission, Seeburger said Price's firing stemmed from "her comments on (Worthington's) testimony," according to notes taken by conference chairwoman Barbara Cook.

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Whether or not Price, who now works for the State Department of Social and Health Services, wins the suit, she said she felt vindicated.

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THE HANFORD GAMBLE

THE OREGONIAN
Portland, OR
MAY 23 1985

D-14
Pg 1 of 4

"I intend to wear out my life on this subject," says one member of an activist group that closely watches the Hanford Nuclear Reservation.

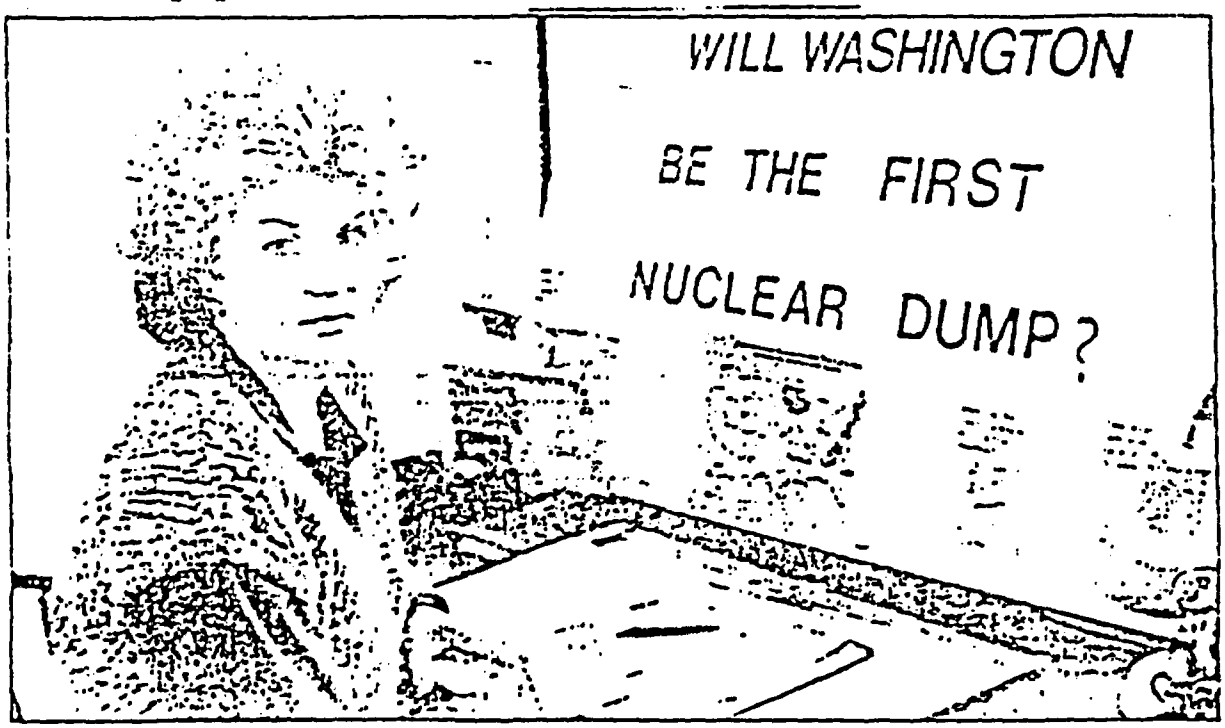
Those activists, and others who take a more pro-Hanford stance, form part of the milieu in which a spent-fuel repository for the nation is being considered.

Details on Page D14, in Day 12 of 15 installments in The Hanford Gamble series.

FRIDAY: Where the money goes.

The Hanford gamble: Activists

Diverse groups share opposition to repository plan



Associated Press

HARD AT WORK — Eileen Buller displays poster used for giving facts about nuclear dumping at Hanford Nuclear Reservation. Buller, president of the Hanford Oversight Committee, opposes government proposal to dispose of nuclear waste at site in Southeastern Washington

By FERN SHEN
of The Oregonian staff

As a girl growing up in Utah, Eileen Buller remembers her parents waking her up at dawn and guiding her to the window in her pajamas to watch a fascinating sight — as sound waves shook the house, a bright light flashed over the desert and a huge cloud blossomed in the sky like a flower.

"It was all presented to me as a good thing," said Buller, 40, whose fascination with things nuclear today is tinged with horror. "I don't want to pass that on to my children — I see that place for what it is now."

The place, not far from her home, was the Nevada Test Site, where the United States detonated 103 aboveground nuclear tests from 1951 through 1963. The explosions were responsible for unusually high rates of cancer and birth defects, claimed downwind residents, some of whom won $2.8 million in damages in federal court in May 1984. The government is appealing the decision.

But Buller, who considers herself in the at-risk population, did not become politically active until later in life, when she lived near the Southeastern Washington federal nuclear complex where bomb material is made, not detonated.

Today she is the president of the Hanford Oversight Committee, the most vocal group criticizing the government's proposal to put the nation's nuclear waste in a 3,200-foot-deep hole at the Hanford Nuclear Reservation, four miles from the Columbia River.

"We thought it was the one thing at Hanford we could stop," said Buller, who now lives in Issaquah, Wash., with her husband, a former Rockwell Hanford Operations worker.

The committee, a coalition of en-

TOR

MAY 23 1985

Pg 2 of 4

vironmental, labor, peace and religious groups from around the Northwest, reflects the diversity of the activists who have mobilized to oppose the repository.

They include peace groups such as Northwest Action for Disarmament, environmental groups such as Sierra Club and anti-nuclear groups such as Lloyd Marbet's Forelaws on Board. The Spokane-based Hanford Education Action League was formed by residents worried over the health risks of living downwind from the reservation on a major transportation route for truckloads of repository wastes.

About a dozen of the activists say they have devoted their lives to uncovering facts about Hanford.

"My dad used to say we shouldn't be working out there, but he never had the guts to do anything about it," said Larry Caldwell a member of the committee who formerly worked at Hanford, as did his father. "I made some pretty good investments, and I'm trying to take that money and use it to turn this craziness around."

"Maybe I have become a fanatic," said former Spokane Magazine editor Larry Shook, now staff researcher for the league. "But I intend to wear out my life on this subject.

"It sounded funny to me the first time I heard it but it's true. There's really a chance that this nuclear buildup could produce an outcome worse than nuclear war. It could reach the point where escalations in disease and genetic damage are so great that it would doom the human race."

Whatever their orientation, however, all of them share a conviction that the government's process of selecting possible sites has been scientifically flawed, hopelessly politicized and unnecessarily hurried and that the choice of a spot in the basalt four miles from the river would be an accident waiting to happen.

"I am concerned that what you have done is set the stage for the biggest technical, financial and human scandal this nation has ever had," the Rev. William H. Houff, president of the league, told U.S. Department of Energy officials at a March hearing in Spokane.

"Indeed, if you continue your present course, I do not merely worry about such a scandal, I predict it."

—

One repeated complaint from activists is that the Energy Department is holding the public at arm's length, instead of involving them in the process.

"Tell me the timing of the EA's was a coincidence," said Joanne Oleksiak, of the Hanford Clearinghouse, a Portland-based group, funded by grants from religious foundations, that collects and disseminates information on Hanford.

The nine, 1,000-page environmental assessments were released five days before Christmas, and Energy Department officials refused to extend the 90-day comment period.

Most Energy Department officials blame the bad blood between them and the public on national anti-nuclear groups, biased reporting, their own failure to communicate and knee-jerk mistrust of the government.

"Nobody believes us," said Michael R. Fox, a staff engineer for Rockwell Hanford Operations, a key Hanford contractor.

But critics "can be manufacturing bubblegum and claim to be a nuclear expert and people will believe them," Fox said.

One longtime activist thinks a tendency to "dismiss the objectors as not-in-my-backyard nuts" is Energy officials' greatest shortcoming.

"Deep down, they still think, 'We're not gonna let these crazy granola types push us around,'" said Ruth Weiner, a Western Washington University environmental studies assistant professor and Sierra Club member

The Energy Department official who presided over the hearings agreed that "we haven't done the world's best job of getting the info out."

"But, whether they know it or not, people have benefited from nuclear power and the security of having nuclear weapons over the years," said Ellison Burton, director of the siting division of the Office of Civilian Radioactive Waste Management. "There's no free lunch."

—

The mushroom cloud again. It appears before a small group of farmers and their families on a projector screen beneath the basketball backboard and American flag of a school auditorium. Outside is tiny Wanupum Dam Village, the chilly, barren moonscape of the upper Columbia River in December and — about 25 miles downriver — the Hanford Nuclear Reservation where the plutonium was made for the bomb that made the mushroom cloud.

"It's the little people who have to grasp this," said Buller, after the talk she gave on Hanford, along with other speakers who discussed the dump proposal and delivered a primer on the health effects of radiation. "Where the people of the state go, the politicians of the state will follow."

Besides putting on road shows like the one at Wanupum, the activists are also fierce photocopiers (one activist got a copying machine for Christmas) and filers of requests for documents under the Freedom of Information Act. They try to raise public consciousness about Hanford by unearthing evidence of its checkered past and unannounced leaks and accidents.

One such request turned up a stack of laboratory readouts that, with the help of Allen B. Benson, a Spokane Falls Community College chemistry professor, revealed that the Hanford plant that isolates plutonium for nuclear weapons had been emitting unexpectedly high quantities of long-lived plutonium into the air last spring, as well as the shorter-lived thorium initially reported.

The activists also take responsibility for two other major developments:

- At least a dozen cities and county governments — including those of Portland, Multnomah County, Spokane and Vancouver, Wash. — formally have opposed the repository.
- Washington residents both know about Hanford and oppose the repository, according to a public opinion poll commissioned by the Spokane Spokesman-Review.

According to the January-February poll, 95 percent of 400 people randomly questioned in Washington had heard about the repository proposal, and 68 percent opposed it. In the Tri-Cities area around Hanford, 96 percent knew about it, and 59 percent favored it.

Energy officials, for their part, realize that they face a major communications challenge. They have beefed up their public involvement budget and are trying to talk in laymen's language.

"It's not as if we're siting a post office or a highway or a stadium," siting director Burton said. "We have to do a better job of — not selling the program — but laying the information out so it can be quickly understood."

The nuclear industry also has rallied to win public approval of the waste site search.

A national pro-nuclear group, the U.S. Committee for Energy Awareness, has hired public relations firms in each of the candidate states to organize speakers and lobbyists and to conduct speakers' polls. The group assigned to the Hanford proposal, the Washington Waste Site Committee, has headquarters in the Portland public relations firm of Bacon & Hunt.

"We are not supporting that site," said Thomas E. Hunt, a partner in the firm, which has a contract with the committee. "But people who are trying to be obstructionist are not helping matters."

NEXT: Who profits?

THE OREGONIAN
Portland, OR
MAY 23 1986

Longtime ties to federal purse still bind

By FERN SHEN
of The Oregonian staff

The atomic umbilical cord connecting Washington (the state) with Washington (the city) has become an important element in the debate over the government proposal to bury the America's nuclear waste at the Hanford Nuclear Reservation.

Envoys from Pasco, Richland and Kennewick, Wash. — the triad of cities clustered near Hanford — journeyed to Washington, D.C., as early as 1974 to ask federal officials to bring the nation's lethal reactor waste to the 42-year-old federal atomic complex that fuels much of their economy.

"We in the Tri-Cities are not concerned about living with the end product," said Sam Volpentest, then president of the Tri-Cities Nuclear Industrial Council, speaking at a 1974 hearing on waste disposal before the Atomic Energy Commission.

Volpentest, still active in the community booster group, apparently felt the same way as recently as last fall.

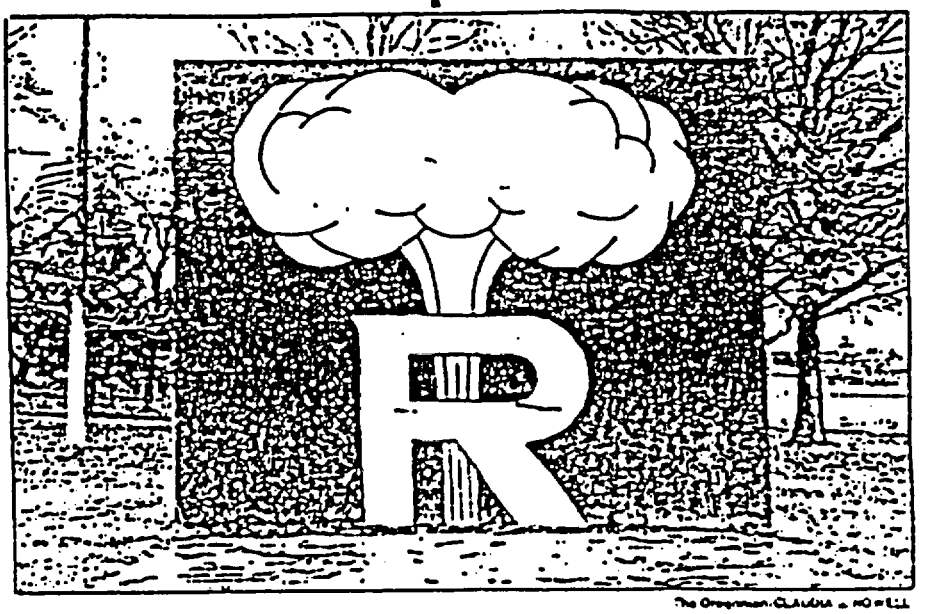
"We have worked on this for quite a while, quietly," he said then. "They tell us it would run into the billions and I don't know how many jobs — we believe that Hanford is the logical choice."

Today, however, community leaders are downplaying their connections to "The Reservation." The council, for instance, has adopted a neutral position on the repository and changed its name to the Tri-City Industrial Development Council, taking the word "nuclear" out of its name.

"There's a big move here now to try not to tie Hanford to the community economy," said William Whiting, a spokesman for the Westinghouse Hanford Co. and a member of the Richland Chamber of Commerce. "There's a movement to diversify."

"They're just beginning to realize that the boosterism makes their presentations look non-credible," said Ruth Weiner, a Western Washington State University environmental studies assistant professor and Sierra Club member who has been following nuclear issues for years.

But with stores closing and service stations boarded up following the cancellation and mothballing of two private nuclear power plants, Tri-Cities residents have good reason to look hungrily at the work force of up to 1,100 at a repository.



HOME TEAM — Sign at a Richland high school, whose teams are called Bombers, expresses atomic ties. Pasco, Kennewick and Richland, Wash., remain heavily dependent on government nuclear activities.

Job prospects are looking even bleaker, in some eyes, because of a plan announced recently by the Energy Department officials who run Hanford to switch from eight major contractors to three. The fear is that fewer contractors will mean fewer jobs overall.

Recognizing the need to become less dependent on the $975 million a year contribution the federal government makes to the Tri-Cities economy, the communities nevertheless remain heavily dependent on the government activities that created them.

The story of how that relationship benefited the community is told and retold, like a revered creation myth, by 80-year-old Volpentest and longtime Tri-Cities boosters:

The 570-square-mile atomic complex was wrested "from the sagebrush and the jack rabbits" beginning in 1943 to manufacture "the plutonium for the bombs that ended World War II," as a pamphlet printed by the Tri-City Herald in 1978 tells it.

Attempts by Congress to cut back the reservation's programs swept over the area in the ensuing years like recurrent floods, with the council always rallying to pile federal dollars against the tide.

Their success was largely due to the combined efforts of Volpentest and fellow council member Glenn C. Lee, backed by the contributions from the local merchants and federal contractors who were members, and represented by some of the most powerful politicians in Congress.

Lee, publisher of the Tri-City Herald until 1979, made no secret of the fact that he spent his own time and his newspaper's money traveling to Washington, D.C., in search of fat federal contracts for Hanford. Stories in the Herald, at times critical of Hanford, more often trumpeted the coming prosperity and the accomplishments of the council.

"It was odd as hell," said Don Pugnetti, a former Herald managing editor who recently retired as editor of the Tacoma News Tribune. "You'd probably never find it happening today."

Over the years, the close connections in "The Town the Atom Built" have produced:

- Millions of dollars worth of capital improvements for the town. When General Electric Co. was phased out as the reservation's sole contractor in the early 1960s, Lee, Volpentest and others worked with the Atomic Energy Commission to bring in contractors who promised to invest a portion of their profits in the community.

The result was the $3 million Hanford House Hotel and Convention Center, the $1 million McGregor Cattle Feedlot, a $5 million meat packing plant, a $12 million office and research

complex, all built by the Atlantic Richfield Co.

• Allegations of conflict of interest. Of 25 members of the council's board of directors, seven work for Hanford contractors. They include Paul G. Lorenzini, vice president and general manager of Rockwell Hanford Operations, the reservation's biggest contractor.

"The council is basically the contractors' lobbying arm," said Larry Caldwell, a Richland member of the Hanford Oversight Committee, a Northwest coalition of religious, labor, environmental and peace organizations. "It's an out and out conflict."

Council President Robert Ferguson said membership in the council did not constitute bias. Ferguson has worked for General Electric Co., the Washington Public Power Supply System and the Energy Department as a deputy assistant secretary, and until recently he was chairman of the company that operates N Reactor, UNC Nuclear Industries.

"We advocate for the whole community," he said, "not individuals."

• Organized bimonthly kibitzing. The Tri-City Caucus, a breakfast group consisting of key congressmen, staff members, Energy officials and contractors meet to talk about everything from new programs Hanford was seeking, federal budget proposals or irradiating food.

TOR

MAY 23 1986

Pg 4 of 4

Booster offers more than just lip service

RICHLAND, Wash. — Take an old Nevada cowboy, pack his saddle bags with a Geiger counter and a chemistry diploma, then send him at a gallop into the nuclear future.

What comes back is a 58-year-old, potbellied atomic advocate named Galen Winsor, who has a dramatic way of making his point that radioactive substances don't hurt you: He eats them.

"It's just another form of suntan," the Richland, Wash., resident said, as he poured a small pile of uranium oxide into his palm, stuck out his tongue and coated it with the yellow powder that, unrefined, is the first chemical step toward nuclear reactor fuel.

"I do this in front of audiences, and they go wild," Winsor said, swallowing and grinning with the pride of one who has just roped an intractable steer.

"I've had people come up afterwards and say, 'Can I eat some, too?' " Winsor said.

Although he has been gulping uranium on lecture tours from Sioux Falls, S.D., to Topeka, Kan., only for a few years, Winsor has been knocking around the nuclear industry for the past four decades: working for the now-defunct Atomic Energy Commission and for private companies, such as UNC Nuclear Industries' Systems and Services Inc. at Hanford as a senior engineer.

ATOMIC BOOSTER — Galen Winsor eats uranium oxide.

He spins tales of atomic misadventure with the hyperbolic verve of a sportsman telling his favorite fish story.

(Late one night in the 1950s, when radioactive, glowing-hot waste from the PUREX plant — which extracts plutonium from reactor fuel — began leaking out of a pipe, remote-controlled repair mechanisms jammed. Winsor said he ignored the rules and manually repaired the mechanisms. Affectionately, he recalled how he "just stood there and watched that crazy stuff burn — and it didn't hurt me a bit.")

From this past, Winsor has forged a peculiar philosophy, perhaps best illustrated by his staunch opposition to burying the nation's high-level nuclear wastes at Hanford, or anywhere else, for that matter.

While other critics oppose the proposed waste repository for fear it eventually would leak, Winsor condemns it for even validating those fears.

"All of this environmental hocus-pocus is nothing but a scare tactic used by the government to boggle our minds," said Winsor.

In Winsor's eyes, anyone who puts spent nuclear fuel under the ground is, quite literally, throwing money down a hole. Better to reprocess the fuel into valuable uranium and plutonium, he said.

State and federal officials who investigated the legality of Winsor's private stock of uranium, are more than a little skeptical about his claims — they regard him as an irresponsible nuisance.

"Winsor's activities are troubling but, technically speaking, quite legal," said Nancy Kerner, supervisor of the waste management unit of the radiation control section of the Washington state Department of Social and Health Services.

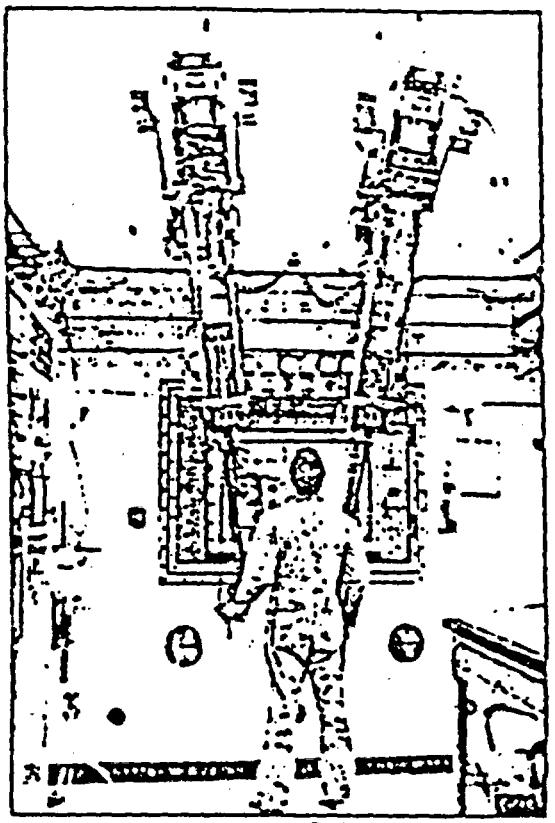
Since the uranium Winsor eats is insoluble and probably "exposes his gut to a few millirem, it's probably not that bad," Kerner said, "but it's irresponsible."

THE OREGONIAN
Portland, OR
MAY 24 1985

C-14
Pg 1 of 4

The economics of radioactive waste

Search for repository offers feast for contractors



The Oregonian/CLAUDIA J. HOWELL

REMOTE CONTROL — Charles Kearney manipulates arms in a cell at the Waste Encapsulation and Storage Facility. Rockwell Hanford Operations, the reservation's biggest contractor, runs the plant in addition to doing studies of a spent-fuel repository.

The 1982 Nuclear Waste Policy Act set in motion a formal process to dispose of the highly radioactive waste from the nation's nuclear power plants. Since the act took effect in 1983, more than $605 million has been spent on the process.

The nationwide contracting figures in these charts include spending only since early in the calendar year 1983, but the Hanford contractor figures include research spending on basalt studies prior to that.

The top 10 repository contractors nationwide

Contractor	Amt. received since '83 (millions)
Battelle Memorial Institute	$213.4
Rockwell Hanford Operations	120.1
Western Electric Co.	50.0
University of California	46.3
Interior Dept., USGS	21.8
Roy F. Weston Co.	16.2
Reynolds Electric Energy Co.	16.4
Morrison Knudson Co. Inc.	12.1
Fluor Engineers and Construction	11.6
Science Applications Inc.	11.1

The top 5 Hanford repository contractors

All figures millions of dollars

Company	1977-82	1983	1984	1985	Spending to date	1986 (est.)	1987 (est.)
Rockwell Hanford Operations	119.2	43.1	43.2	51.3	255.8	93.2	114.8
Battelle Pacific Northwest Laboratory	—	2.2	3.1	3.2	8.5	5.3	5.1
Westinghouse Hanford Co.	—	1.1	1.9	3.2	6.2	5.3	5.1
Morrison Knudson Co. Inc.	—	4.4	3.3	5.2	13.5	11.9	47.5
Raymond Kaiser Engineers Parsons Brinckerhoff Quade and Douglas	—	—	3.0	2.1	5.1	7.2	5.5
All others	49.5	3.4	5.2	5.1	63.2	10.4	12.3
Total	168.7	54.3	59.7	71.1	353.7	133.3	190.4

Sources: U.S. Dept. of Energy, U.S. General Accounting Office, Rockwell Hanford Operations, Battelle Memorial Institute

The Oregonian

By FERN SHEN
of The Oregonian staff

The contractors dining on a multi-million-dollar program to pick a national nuclear tomb are facing the prospect of a generous second helping when the program steps up in two years and a virtual banquet when the time comes to build the $25 billion cavern for nuclear reactor wastes.

Take the example of Morrison Knudson Co. Inc., the construction manager for the repository project at the government's Hanford Nuclear Reservation, which straddles the Columbia River in Washington.

If Hanford's tentative ranking in the top three is confirmed and it is among the sites intensely studied, the Boise-based company can expect its Hanford revenues to increase seven-

THE HANFORD GAMBLE

fold between 1985 and 1987 — from $6.2 million annually to $47.6 million, Energy officials say.

If, after that five-year study process, Hanford is picked as the site, the potential business for Morrison Knudson would skyrocket.

"We hear numbers literally in the billions," said Lyell Bingham, subcontractor administrator for the company.

Critics worry that the high stakes these companies are playing for have already undermined the process of selecting the site for the world's first repository. They fear the profit motive will lead to a poor choice and a dangerous home for 77,000 tons of highly radioactive waste.

"It's in the best interest of all of these companies to ensure the longevity of these projects," said Carl O. Johnson, chief of technical programs for the state Nuclear Waste Office in Nevada, where a site near Yucca Mountain was also tentatively named one of the top three sites. "That fact tends to put a very rosy light on things. ... It also will end up giving us an unsafe repository."

TOR

MAY 24 1985

Pg 2 of 4

Officials at the Energy Department, which runs both Hanford and the dump search program, say they are wary of the contractors' influence but maintain that it is not threatening the safety of the venture.

"In the end, the question is whether we're capable of judging the quality of their work," said Roger Gale, director of the Office of Policy, Integration and Outreach for the department's waste program. "And I think we are."

But critics fear the stage is set for trouble:

• Although the department's contractors and subcontractors number in the hundreds, a relatively small number of contractors have dominated the program so far. Just two companies — Rockwell International and Battelle Memorial Institute — have received over half of the $605.4 million spent since a 1982 federal law set up the national program, according to a Jan. 31 report by the U.S. General Accounting Office.

At Hanford, Rockwell Hanford's contract makes up 72 percent of the fiscal-year 1985 budget of $71.1 million to do basalt repository studies.

• The same companies that have done the early studies of the sites are conducting the later, more lucrative studies. The still-larger contracts to build the proposed repository will be competitively bid, Energy Department officials promise, but no provision has been made to prevent the same companies from winning those contracts.

Already, some critics charge, the companies have exaggerated the merits of the sites they are studying.

"We're still hearing the same kind of things from people, that data is being cut to fit," said Ruth Weiner, a Western Washington University environmental studies assistant professor who has been following Hanford waste issues since 1959.

If data are being manipulated "it should not be the case," said Michael J. Lawrence, the Energy Department's operations manager at Hanford. "We've made it clear to them — a good job is quality data."

Whether or not potential profit has undercut the integrity of the program, however, some contractors undeniably will cash in as the government spends an estimated $2.2 billion for "site characterization" studies to determine which of three finalists is the best site. The Energy Department estimates the costs at $870 million for Hanford; $630 million at Yucca Mountain in Nevada; and $695 million for the site in Deaf Smith County, in the Texas Panhandle.

Rockwell Hanford expects its authorized 1985 expenditures of $51.3 million to more than double in two years to $114.8 million.

A review of some of the prominent contractors suggests some of the questions that have arisen:

Rockwell Hanford Operations

A division of Pittsburgh-based Rockwell International, a defense contracting giant, Rockwell Hanford oversees studies of the waste disposal potential of Hanford's basalt. Those studies are part of the larger contract it was awarded in 1977 to perform other duties — run a plant that produces plutonium for bombs, manage the resulting waste and maintain a security force to safeguard the 42-year-old desert complex. Already renewed once in 1982, the company's performance-based contract expires again in 1987.

Rockwell Hanford's early reports on its basalt studies were scathingly criticized by independent and government scientists alike. Today, Energy officials concede that the early work was "overly optimistic" but insist that they have curbed Rockwell's enthusiasm.

Energy officials say they could not declare that Rockwell will be prohibited from bidding on the contract to build a repository, as some have suggested.

However, the company would be unlikely to seek the contract anyway, since Rockwell International "is not a construction-oriented company," said Barry C.K. Moravek, communications and public affairs administrator for Rockwell Hanford.

Moravek added that "the construction contract will not be let for a long time," and the company's orientation could be different by then.

Perceived or actual bias during site characterization could be eliminated, one critic suggested, by forming a consortium of companies that would jointly supervise the studies on all three sites.

"A consortium would effectively eliminate that bias," said Steve Frishman, director of the Texas Nuclear Waste Office. "Over at DOE, the idea falls on deaf ears."

Roy F. Weston Co. Inc.

The company has a central role in the federal repository program, but had no experience in nuclear waste before it won a $39 million technical support contract in 1983.

Weston, which is based in Pennsylvania but has offices in Rockville, Md., provides technical expertise for the Office of Civilian Radioactive Waste Management, the part of the Department of Energy running the program.

Critics call Weston "a shadow company" and say that the company, not the DOE, makes policy.

"They essentially are the Office of Civilian Radioactive Waste Management," said David M. Berick, director of the nuclear waste program of the Environmental Policy Institute, a national public interest research and information group based in Washington, D.C.

Energy Department and Weston officials agree that "many people were really surprised" when Weston, a relative unknown in the nuclear industry, won the five-year contract for the project. But they defend the choice and say that the company's role is to provide skilled backup, not to make policy.

Weston "did a lot of analysis, pulled a lot together" to write Chapter 7 of the environmental assessments, said Gale. The chapter explains how the department narrowed the original pack of nine candidate sites to a tentative three.

"They were involved in pieces of the decisions," said Gale, "but they were our decisions."

David Siesken, an associate program manager for Weston, reacted strongly to the contentions that the company initially was too inexperienced and since then has acquired undue influence.

"I really resent the implication that we are the heavy," said Siesken.

He recalled that there was "a transition period" when the company began its work following the passage of the 1982 Nuclear Waste Policy Act.

"No doubt about it, there's a learning curve," said Siesken. "But it would have taken time for any contractor to get up to speed."

Weston provides engineers, geologists and other technical staff for the divisions of the Office of Civilian Radioactive Waste Management: policy, geologic repositories and transportation and storage.

The only related work previously done by this privately held company, according to Siesken, is in designing and cleaning up hazardous waste sites. Much of the technical advice Weston offers is supplied by its five subcontractors: Jacobs Engineering Group Inc. of Pasadena, Calif.; Williams Brothers Engineering; United Engineering and Structures; ICF Inc.; and Rogers & Associates.

Battelle Memorial Institute and subsidiaries

Having received more than $800 million in federal nuclear waste-related contracts, Battelle is easily the king of nuclear waste management companies.

"We're the biggies," agreed William V. Merriman, institutional analyst for Battelle at the company's Columbus, Ohio, headquarters. Although the company has has divisions in Seattle, Richland, Wash., Germany and Switzerland working on projects that range from troubleshooting on the space shuttle to breeding miniature swine, it is most heavily dependent on nuclear waste-related research.

Battelle's current contracts include:

- A $200 million, five-year contract to oversee studies of granite in the North Central states, being considered as the rock medium for the second spent-fuel repository.
- A $386 million contract to coordinate studies of salt sites in Texas.
- About $213 million worth of contracts to the company's Pacific Northwest Laboratory division for other waste-related research.

The latter includes a fiscal year 1985 contract of $4.1 million for the Hanford basalt program, according to figures Secretary of Energy John S. Herrington provided to Sen. Mark Hatfield, R-Ore., after a March hearing.

Until 1983, Battelle had earned $267 million through a contract to support the Energy Department's repository program staff, the contract later awarded to Weston.

Battelle officials declined to say what portion of their business comes from nuclear waste-related work, but James Hunkler, coordinator of corporate communications, noted that the company's total research work for 1984 amounted to $482 million.

With so much of the work for the repository program being done by Battelle, Texas waste office director Frishman worries about the company's influence.

"I hold Battelle responsible for the position DOE has held for all of these years, which is that DOE has enough information to make a decision," Frishman said. " 'Let's get on with the program, 'cause the bucks are bigger later.' "

How does one company become so dominant? Even nuclear critics concede that, because of the sophistication required to do nuclear work, a limited pool of expertise is available.

"There's just nobody else out there to do this kind of work," said Fred C. Shapiro, author of "Radwaste," a 1981 book on the nation's radioactive waste problems.

But Battelle helps the process along by making itself even more indispensable, Frishman said.

NEXT: The arsenal.

THE OREGONIAN
Portland, OR
MAY 24 1985

Department of Energy's purse snaps up technical experts

By FERN SHEN
of The Oregonian staff

A few years ago, the engineers who ran Golder Associates faced a classic business decision:

They could keep working for agencies critiquing a plan to build an underground nuclear waste crypt at Hanford, or they could work for the U.S. Department of Energy, which has been hatching those plans.

Because of conflict-of-interest laws, they could not work for both: because of simple economics, they chose the Department of Energy.

"We had to make a fiscal decision," said James Voss, an associate with the Seattle-based Golder, whose Energy Department contracts now total about $2 million. "Golder will never work for the NRC again.

"We can't ever be in the position of reviewing some of our own past work."

Since its passage in late 1982, the Nuclear Waste Policy Act (referred to in some circles as the "Geoscientists' Full Employment Act") has boosted the Energy Department's nuclear waste budget from $218 million to $327 million.

That has fueled a furious competition for nuclear engineers, geologists, geophysicists and hydrologists — a competition that states, Indian tribes and other federal agencies often lose.

"There are only so many competent people out there," said David Stevens, director of Washington's High-Level Nuclear Waste Management Office. "And we have a hard time getting them."

"Basically, the Energy Department eats everybody up," said Jim Davenport of Seattle, who is working as a special deputy attorney general for Nevada to handle a suit by the state. Nevada is seeking federal funding for independent field studies of the proposed repository site there.

A lawyer at the Nuclear Regulatory Commission also is troubled by the situation.

The public should be concerned "whenever there is not another organization that verifies the work — whenever there is only one body of expertise," said William Olmstead, director of the Regulations Division at the Office of the Executive Legal Director at the NRC.

"What you see are contractors using the states and the NRC as a stairstep to a larger contract with the DOE," Olmstead said.

Part of what compels scientists to work for the Energy Department is the way the laws governing conflict of interest are written.

Once an individual starts working for the Energy Department on a given issue, federal conflict-of-interest regulations keep that person from taking a private job handling the same work, Olmstead said.

"Basically, the government can hire anybody it wants, but private companies cannot hire somebody who has worked for the government," he said.

States, meanwhile, are less likely to hire a company to review repository work if the company already has worked in the same field for the Energy Department. The potent combination helps keep contractors with the Energy Department once they get there.

The obvious compulsion to go to work there to begin with, however, is the size of its budget.

"Look how much more federal money is available than state," said Michael Cummings, an assistant professor of geology at Portland State University who bid on $547,000 worth of Energy Department contracts for his department.

"If you have an interest in science," Cummings said, "you'd have to be a fool to ignore that."

Golder's succession of employers — first the NRC, then, briefly, the state of Washington and, now, the

TOR

MAY 24 1985

Pg 4 of 4

U.S. Energy Department — is a classic contractor trajectory.

Golder began nuclear waste work for the NRC in the mid-1970s developing the regulations that ultimately will be applied to repositories, but the company's contracts began to decrease by half each year as the NRC cut back on contracted work, Voss said.

The reason, as Voss put it, was NRC's "philosophical change" toward building its own technical staff, and lessening its dependence on contractors.

Golder began picking up Energy Department contracts that, according to Voss, the NRC at first judged not to conflict with the NRC work.

(NRC contracts are written so that the consultant must report possible conflicts and the agency rules on them.)

Eventually, however, Golder sought a major job working on the Energy Department's studies of the waste disposal potential of salt domes; the NRC ruled that it would have brought a conflict.

"They thought we might have been in the position of having to review our own work," Voss said. The NRC rejected Golder's attempts to resolve the conflict by setting up separate companies, he said.

For about a year, Golder was the lead contractor for the state of Washington, during which time the firm wrote a scathing review of the 1982 Site Characterization Report on the Hanford repository site. But the firm decided not to rebid for the contract because, as Voss put it, "It became clear that the contract volume we could ever expect from Washington was not great."

Today, Golder has a major contract to study the repository potential of granite in the North Central United States and at least $1 million in other Energy Department contracts.

Bill to compensate landowners for wild game damage shrivels

By JOHN HAYES
Correspondent, The Oregonian

SALEM — A controversial measure to require state compensation via licensing fees for landowners whose crops are damaged by wild animals perished quietly in committee Wednesday.

Members of the House Agriculture, Forestry and Natural Resources Committee didn't consider the bill after Bernie Agrons, D-Klamath Falls, the panel's chairman, said state officials had agreed to set a new statewide policy on the issue.

House Bill 2726, introduced by Rep. Liz VanLeeuwen, R-Halsey, at the request of the Oregon Farm Bureau Federation, also would have allowed property owners to trap or kill birds or animals found to be damaging crops, trees, domestic animals or other property.

In emergency situations, the wildlife could have been killed without a special permit from the state Fish & Wildlife Department.

However, the bill's major sections would have allowed claims of up to $10,000 to compensate landowners, including timber companies, for wildlife damage, with the money to come from fishing and hunting license fees.

During two hearings on the measure, farmers testified that deer, elk and geese were damaging crops all over the state, with a growing amount of damage being reported from flocks of geese feeding in grass-seed fields in the Willamette Valley.

The bill was opposed by John R. Donaldson, director of the Department of Fish & Wildlife, who said a compensation program would be an endless expense for the state and would not do anything to control the damage.

Agrons urged abandonment of the bill in favor of ratification of an agreement between the committee and the state Fish and Wildlife Commission to set a new state policy on wildlife damage.

Agrons said he had negotiated the agreement with Donaldson and the chairman of the commission, Gene Morris of Ashland, and was satisfied that the state officials fully intended to hold hearings and draft a new policy.

He produced a draft of a letter he proposed to send to the commission outlining the committee's concerns and urging the formation of a special task force to evaluate the damage problem and raise public awareness of the problem.

"I wonder if this is just another way for the department to postpone managing the problem out there," VanLeeuwen countered. "Increasing elk herds out there are causing real damage. Agriculture and forestry are having enough problems the way things are just trying to exist."

Donaldson testified that his department was committed fully to carrying out the agreement negotiated with Agrons.

"We are very, very serious about this," he said. "The product will be a policy on game damage for the department to operate from."

Donaldson predicted the new policy effort would produce a faster solution to the problem than would HB2726 and that solutions to the problem of geese in the Willamette Valley could come in time to relieve concerned farmers by this winter.

As a partial solution to the elk problem in the northwest corner of the state, Donaldson said he favored issuing a set of 100 discretionary elk-killing permits to a state biologist in the area. After reports of elk damage to crops, the biologist could call in hunters and issue the permits on the spot.

THE OREGONIAN
Portland, OR
MAY 23 1985

B-1
pg 1 of 3

THE HANFORD GAMBLE

Reprocessing of nuclear fuel, which yields fuel that can be recycled to produce power in a reactor, also yields plutonium for U.S. nuclear weapons.

Critics charge that sending civilian spent-fuel to the Hanford Nuclear Reservation could be used to expand the arsenal.

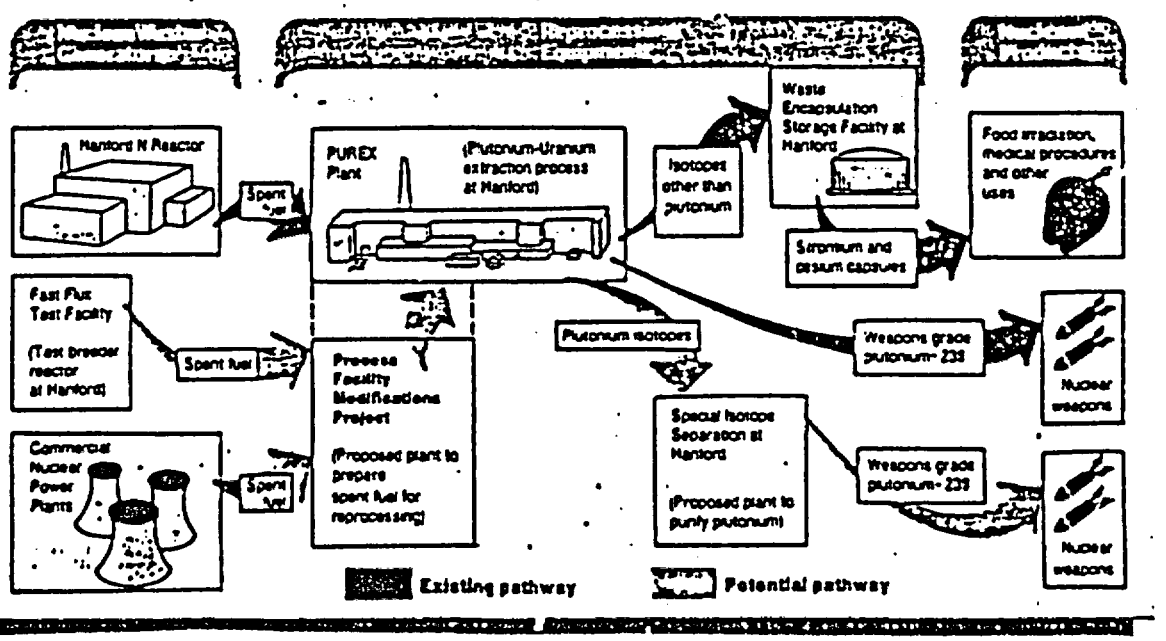
Details on Page A12, in the 14th of 15 installments in The Hanford Gamble series.

SUNDAY: Who pays, and the search for solutions.

Possible military use shadows waste disposal plan

Paths to plutonium

With the already-proposed Process Facility Modifications Project, the Hanford Nuclear Reservation would be able to prepare spent fuel from commercial nuclear reactors for extraction of plutonium, the fuel used in nuclear weapons. Long-standing U.S. policy has been to reprocess only fuel from defense reactors, thus keeping civilian and military uses of the atom separate. If that were to change, as some in government and industry advocate, the commercial fuel in the proposed Hanford repository would be available for reprocessing. The design would allow the fuel to be retrieved for at least 50 years after the first canister is buried.



TOR
MAY 2 3 1985
Pg 2 of 3

By FERN SHEN
of The Oregonian staff

One man's nuclear trash may be another man's military treasure. Underlying the debate over what to do with commercial highly radioactive waste is the fact that, in some circles, spent reactor fuel is not waste at all.

About 400 metric tons of weapons-grade plutonium (roughly, 45,000 to 90,000 bombs) could be extracted from the 77,000 tons of spent fuel the government plans to put in an underground vault by the turn of the cen-

tury, according to Thomas B. Cochran, senior staff scientist at the Washington, D.C.-based Natural Resources Defense Council.

The amount is about four times the supply of bomb-grade plutonium currently in reserve for the weapons program, according to calculations by Cochran.

Critics say that one unstated reason the Energy Department would like to build a repository for that commercial fuel at the Hanford Nuclear Reservation is that the 42-year-old Southeastern Washington nuclear complex would be a perfect cache for this military nest egg — the reprocessing facilities needed to extract the plutonium are either proposed or already there.

The law that sets the nation on this multibillion-dollar search for a repository specifies that the civilian fuel must be retrievable for an unspecified period of time.

The draft environmental assessment on the Hanford site sets the time period as up to 84 years after the first spent-fuel canister is buried.

Energy officials say that is so workers can get to the fuel in case something goes wrong. However, the 1982 Nuclear Waste Policy Act says retrievability is both for safety reasons and "for the purpose of permitting the recovery of the economically valuable contents of such spent fuel."

Critics emphasize the latter provision.

"It's more than a coincidence that here we have (Hanford) gearing up with the technology to beat plowshares into swords," said Robert J. Alvarez, director of the Nuclear Power and Weapons Project of the Environmental Policy Institute, a national public interest research and information group based in Washington, D.C. "And at the same time they're talking about bringing all the plowshares to Hanford."

George W. Rathjens, a nuclear proliferation expert, agreed.

"It's right to be concerned about it — it's a crazy idea," said Rathjens, a Massachusetts Institute of Technology political science professor who has worked for the U.S. Department of Defense evaluating weapons systems.

But Energy Department officials disagree strongly with the suggestion that there is a militaristic "hidden agenda" behind the consideration of Hanford.

"We have no plans to do that; we haven't even considered it, though I can't speak for the past," said Ronald Cochran, deputy assistant secretary for nuclear materials.

According to Gerard C. Smith, head of the U.S. delegation to the SALT I talks in Helsinki and Vienna from 1969 to 1972, the Energy and Defense departments "have a long-running interest in reprocessing civilian spent fuel."

"If they're the same crew I've always known, they're still pushing that one," he said.

Deputy Secretary of Defense Frank C. Carlucci expressed that interest in a March 1982 letter to Sen. John G. Tower, R-Texas. "The option to use civilian plutonium in the weapons program should not be foreclosed," Carlucci wrote, "because we may need to provide for a sudden unforeseeable increase in need resulting from an overriding national security requirement."

Ever since the devastation of the Hiroshima and Nagasaki bombs gave even their creators pause ("It would be nice if it could cure the common cold," Enrico Fermi, the first to achieve a controlled nuclear chain reaction, remarked, according to fellow physicist J. Robert Oppenheimer), American policymakers have been promoting peaceful uses of the atom here and abroad. Military and peaceful uses must be kept separate, they have stressed.

Congress reaffirmed that resolve by approving the 1983 Hart-Simpson amendment to the Atomic Energy Act of 1954, which prevents the reprocessing of civilian spent fuel for military uses.

Consequently, the Energy Department continues to run government "defense reactors," at Hanford and Savannah River near Aiken, S.C.

Fuel rods from these reactors are taken to a plutonium-uranium extraction plant and dissolved in acid, and plutonium for weapons and uranium for later refining for weapons use are extracted.

At Hanford, the N Reactor and the PUREX plant are the remnants of a plutonium-making operation that once included as many as nine reactors and five processing plants. During the 1950s and 1960s, the desert atomic complex produced about 50 metric tons of weapons-grade plutonium — about half of the nation's stockpile, according to "Nuclear Weapons Databook," an unpublished compendium of information on the U.S. weapons program put together under the direction of the Natural Resources Defense Council's Cochran.

(Databook figures are derived by calculations made using publicly available sources. Information on plutonium output is classified.)

But Congress has increased funding dramatically for the Energy Department's plutonium-production program in recent years as part of Reagan administration campaign to build up a surplus of plutonium.

The Energy Department's budget for producing nuclear weapons materials nearly quadrupled between 1980 and 1984, going from $482.6 million to $1.864 billion, according to Karen J. Wheeless, a public affairs specialist at the department's Richland Operations office.

During that time, nuclear material production expenditures at Hanford went from $120.8 million to $412 million. The department spent $150 million to ready the PUREX plant for restart in November 1983 after 12 years of dormancy and converted the N Reactor so it would produce higher quality, weapons-grade plutonium.

(From 1973 to 1982, the N Reactor had produced rods with lower-quality, fuel-grade plutonium.)

Total defense-related spending at Hanford now accounts for 60 percent of Hanford's fiscal 1985 budget of $975 million.

During the 1970s, most of the reservation's budget had gone into non-military energy research.

Officials at the Energy Department, which supplies plutonium and other warhead materials to the Department of Defense, have used a number of different arguments for building up the plutonium stockpile.

A reserve may be needed "as insurance against unforeseen ... production interruptions and to allow for surge capacity," according to a December 1982 Energy Department document submitted to support the department's budget requests.

The production drive was intended to replace the entire nuclear arsenal and to add about 17,000 more warheads for the new generation of weapons — the MX, submarine-launched Trident missiles and others.

Rathjens, who helped draft the 1970 Nuclear Non-Proliferation Treaty, maintains that the buildup is unnecessary.

THE OREGONIAN
Portland, OR
MAY 23 1985 Pg 3 of 3

"It's off the wall," Rathjens said. "It's the (Department of Defense) adding up all the things on its wish list and assuming it's going to get them all."

The Energy Department's Cochran, however, stressed that "the main reason for the additional plutonium requirement" was that "the age and deterioration of the weapons system" requires that the weapons stockpile "has to be modernized and replaced."

For whatever purpose, Energy officials have sought the funds to replace the 20-year-old N Reactor at Hanford and the aging defense reactors at Savannah River near Aiken, S.C. So far, Congress has refused to fund the $3 billion to $6 billion New Production Reactor. But Energy officials have complained to Congress that the U.S. efforts to build up plutonium are still hamstrung because the United States cannot reprocess commercial reactor fuel for military purposes, and the Soviets can.

The limitations of even the stepped-up campaign were given by a department official testifying before the Procurement and Military Nuclear Systems Subcommittee of the House Armed Services Committee in February 1984.

"Even with all the new initiatives ... we will still be producing at a rate that is less than the peak rate experienced in the late '50s," said F. Charles Gilbert, then-deputy assistant secretary for nuclear materials.

"The U.S.S.R is not constrained to using only defense-dedicated reactors. ... They can increase their plutonium availability by employing civilian power reactors," said Gilbert, who proceeded to show the lawmakers a graph comparing the two countries' plutonium production.

Even if the law prohibiting defense uses of spent-fuel rods were repealed, however, there would still be technical difficulties in transforming the repository's fuel rods into warheads.

Because commercial fuel rods stay in the reactor for three years, compared to a few weeks or months for defense reactors, the rods contain several kinds of plutonium in addition to the weapon-fueling plutonium-239, including plutonium-240, considered an impurity.

Also, some commercial rods are surrounded by stainless-steel cladding. The PUREX plant is equipped to dissolve only zirconium alloy cladding.

Two new plants the department proposes to build at Hanford — the Process Facility Modification Plant and the Special Isotope Separation plant — would enable the government to "clean up" commercial spent fuel for reprocessing.

Energy officials concede that they considered using the plants for this purpose as recently as last year, but they say that the plants now are intended for "dirty" fuel from other, non-commercial reactors.

Reprocessing commercial fuel for bombs would require a change in the law, noted Michael J. Lawrence, manager of the department's Richland Operations office.

"I know of no plan by the Department of Energy or any member of Congress to propose such legislation," said Lawrence in a letter to The Oregonian printed Jan. 5.

Alvarez remains unconvinced. "The only way that it would be economic for the DOE to run those plants is if they plan to reprocess commercial fuel," he said of the proposed Hanford plants.

The $250 million process facility plant would include choppers and dissolvers that would prepare fuel from the Fast Flux Test Facility and miscellaneous research fuel for use in PUREX. An environmental impact statement on the proposal is due out in early 1986, according to the Energy Department's Wheeless.

The $750 million Special Isotope Separation facility, originally described by the department before the House Armed Services Committee in 1982, could prepare several kinds of fuel — including commercial spent fuel — for weapon-grade extraction. The plant has not been authorized by Congress, however.

Despite the department's denial that defense reprocessing of commercial fuel is in the future, some Hanford employees talk as if commercial spent fuel is definitely destined for reprocessing at Hanford.

Robert W. Higbee, Rockwell's manager of the Waste Encapsulation and Storage Facility, noted during a tour of his facility that PUREX eventually would process, not only spent fuel from the N Reactor, but "power reactor fuels as well."

"That decision has not been made yet, has it?" interjected Barry C.K. Moravek, the administrator of communications and public affairs for the repository project at Hanford. "You're just peering into the future."

NEXT: Who pays, and science tackles nuclear waste.

Look beyond Hanford to bury nuclear waste

THE OREGONIAN
Portland, OR
MAY 26 1985

B-2

The Pacific Northwest may well have a geologically suitable location in which to build America's first permanent nuclear waste repository, but the proposed Hanford Nuclear Reservation site clearly is not it.

If political considerations were stripped from the criteria for selecting the repository, leaving only a scientific basis for the decision, Hanford's half-life as an acceptable disposal site would be measured in hours.

The Hanford site, as a permanent resting place for spent nuclear power plant fuel rods and the military's radioactive wastes, poses a potential threat to future health and livability of the Northwest region.

Never mind the political advantages: that Hanford is 570 acres of government-owned desert with a history since World War II as a nuclear complex; that it has the support of residents in the Tri-cities area of Southeast Washington, many of whom depend on Hanford for their incomes; that it has enjoyed more than four decades of state and federal political support from a variety of public officeholders. None of this should override emerging scientific evidence that argues strongly that there must be better sites available in the nation, as well as in this region.

The Hanford site should be discarded as unsuitable. Northwest congressmen need only read the 15-part series, "The Hanford gamble," which concludes in The Oregonian Sunday, to question the logic of the federal Department of Energy for selecting Hanford in the first place as one of three finalists for the nuclear dump.

The proposed Hanford repository, unlike the other finalist sites in Texas and Nevada, is located only four miles from the second-largest river system in the continental United States. Downstream from Hanford lies a 343-mile stretch of multipurpose river, cutting through $52 billion of riverfront real estate, serving communities of more than 2 million people, and supporting tourist, fishing and recreation industries of immense value. It makes no sense to place such a valuable resource and the people it serves at risk

Computerized ground water models cannot predict with accuracy or long-term certainty that radioactive materials from the Hanford repository will not be carried with underground streams into the Columbia River someday. There are no government guarantees, just estimates from several studies that show that it might take as little as 1,000 years for deadly nuclear waste to travel from the Hanford repository site to the river.

The Deaf Smith County, Texas, site, for that matter, is not very encouraging either. To place a repository 2,500 feet deep in rock salt there would require drilling through two major aquifers, one of which is a primary source of drinking water and irrigation in a major agricultural region.

The Oregonian still believes that high-level nuclear wastes can be permanently and safely stored and that suitable sites — within the Northwest, in fact — can be found to protect the public's health and safety and the environment from this legacy. However, the timetable and guidelines for choosing the first site under the 1982 Nuclear Waste Policy Act are too inflexible to allow the government to retreat from the three finalist sites, even though negative evidence continues to pour in on all three candidates.

If government officials decided they wanted one of the repositories to be located in a basalt formation, the Pacific Northwest could still offer a good candidate site. But why not focus on a site adjacent to Hanford, many miles removed from the Columbia, thus eliminating the proximity-to-river problem that so severely plagues the Hanford site? It would require land purchases, but in the multibillion-dollar cost of this job, that is a minor consideration.

The Oregonian fears that this process is a chain reaction out of control. The government already had spent $353.7 million examining the Hanford site before the 1982 act was passed. It plans to spend another $500 million to $1 billion on the Hanford study during the next six years. Such an expenditure may produce little more than an unbreakable political and bureaucratic momentum to select the ill-advised Hanford site as one of this nation's permanent nuclear waste dumps.

THE OREGONIAN
Portland, OR
MAY 26 1985

B-1
Pg 1 of 11

Nuclear reactor waste dumps: Ratepayers will foot the bill

By FERN SHEN
of The Oregonian staff

It might cost $25 billion — the equivalent of 32 Bonneville Dams or 81 Banfield Light Rail Projects.

Then again, it might cost $114 billion — equal to 145 dams or 371 light rail systems.

It might result in a nuclear crypt a few miles from a Nevada underground nuclear test site, 3,000 feet below a Texas Panhandle seed farm, or 240 miles upstream from Portland near the Columbia River.

But one thing is definite about the program designed to create the nation's first permanent nuclear reactor waste dumps: Ratepayers will foot the bill.

The 1982 Nuclear Waste Policy Act removed the albatross of nuclear waste from utilities' necks and fastened it securely onto ratepayers and the government. And the weight already shows signs of growing.

In 1982 congressional testimony, Energy Department officials predicted that costs for an underground repository would range from $5 billion to $7.6 billion. Today, officials are planning that repository and a second one also provided for in the act. They figure the cost, including transportation of fuel rods, at about $25 billion.

But the U.S. comptroller general reported in January that a 5 percent inflation rate and higher materials and labor costs could drive the cost of siting, building, filling and closing two repositories as high as $114 billion.

"There really are some parallels to nuclear plants themselves," said Edwyna G. Anderson, a commissioner in Michigan's Public Service Commission. "We're seeing the same time lags and potential for massive overruns."

The costs will be paid through the Nuclear Waste Fund, established in the 1982 Nuclear Waste Policy Act. The fund receives a one-tenth-of-a-cent fee for every nuclear-generated kilowatt-hour. By the end of April, ratepayers had contributed $659.4 million to the fund.

The fund also will take in more than $2.3 billion in payments from utilities for the costs of disposing of waste accumulated before the law went into effect. But, if state utility regulators approve, utilities could pass those charges on to ratepayers, too, said

Ronald A. Milner, acting director of the Energy Department's repository cost analysis division.

"The act provides, in the most appropriate private-sector, free-enterprise statement imaginable, that those who benefit from nuclear power will pay the costs of the program," said Benjamin C. Rusche, director of the Energy Department's Office of Civilian Radioactive Waste Management, which is in charge of repository building.

Critics point out that the ratepayers of the future will be paying for spent fuel generated before the act went into effect. Others worry that no one is watching where the money goes.

"The utilities aren't watching it because they pass it on to the ratepayers, and Congress isn't watching it because it's not appropriated money. Very little has happened to watchdog them," said Ruth F. Fleischer, an aide to Sen. William Proxmire, D-Wis., on environmental and energy matters. Proxmire sponsored the state-veto provision in the Nuclear Waste Policy Act, and his office is monitoring the act's implementation, Fleischer said.

The National Association of Regulatory Commissioners formed a nuclear waste disposal subcommittee to explore the risks for the ratepayer.

"We're the only ones with no vested interest, willing to look out for ratepayers," said Peter A. Bradford, chairman of the Maine Public Utility Commission and a member of the subcommittee.

The U.S. General Accounting Office and the Energy Department itself already have concluded, however, that the Nuclear Waste Fund will run into deficits.

The GAO estimates that by 2040, deficits could be between $9 billion and $16 billion.

The Energy Department, in its February "Fee Adequacy Report," anticipates, at worst, a $1 billion deficit by then. Department officials say, however, that they don't expect to have to rely on Congress for appropriations.

"We're at a very early stage of the program," Milner said. "This thing is going to be running for 80 years."

Oregonians so far have paid $10.8 million into the fund for the operation of the Trojan nuclear plant near Rainier, according to William Babcock, public information officer for plant operator Portland General Electric Co. That amounts to $4.80 per year for the average PGE ratepayer.

Washington Public Power Supply System customers will be paying about $7 million per year, or $20 per ratepayer, beginning in 1986, according to WPPSS spokesman Steve Irish.

Complicating the projections is the recent slowdown in construction of nuclear power plants. In the last two years, government estimates of annual nuclear power generation by the year 2000 have fallen 21 percent — meaning lower revenues for the fund.

Even that is too optimistic, said Bradford, of the Maine utility commission.

"My guess is that utilities will never order another plant," he said.

Related stories on Pages A22 and A23.

THE OREGONIAN
Portland, OR
MAY 26 1985

A-22
Pg 2 of 11

The Hanford gamble: No quick fix

Officials hope to put waste back in Pandora's box

Last in a series

By RICHARD READ
of The Oregonian staff

The nuclear milk has spilled.

There's no crying now about the acres of contaminated soil at the Hanford Nuclear Reservation; or about the highly radioactive residue in and around Hanford's underground tanks; or about other remnants of a technology pioneered before scientists knew how to control its waste.

There's no way to take back the nuclear power industry's 13,600 tons of glowing spent fuel, which the U.S. Department of Energy plans in an unprecedented effort to bury in a deep tomb, perhaps at Hanford.

No matter what one thinks about the bomb factories, the power plants and the numerous nuclear industries, the waste they created can't be wished away. Something must be done with the refuse, which was created in four decades but contains some material that will remain significantly radioactive for hundreds of thousands of years.

Industry and Energy Department officials, conscious that the lack of a permanent resting place for spent fuel has hindered nuclear growth, say their experts can use current technology to solve the problems.

"The only real problems associated with the disposal of nuclear wastes are political, not technical," wrote Jon Gilbertson, nuclear engineering director for Fusion Energy Foundation, in a 1980 statement that has become an industry motto.

The industry's critics, some of whom hope that the waste issue will bring the nuclear culture to its knees, profess skepticism. Many say they are particularly worried by the idea of building a repository in Hanford's basalt layers four miles from the Columbia River.

"Nobody's ever tried, or even wanted, to build anything in a basalt formation before," said David M. Berick, director of the nuclear waste program of the Washington, D.C.-based Environmental Policy Institute, a national public interest research and information group. "To argue that the technology's there before you've tried it I think is far-fetched."

A 1983 National Academy of Sciences report described repository technology as "preliminary," with "uncertainties" needing further research. But the report was optimistic about the prospects for development of safe disposal methods.

"If we're smart enough to come up with nuclear science in the first place, we're smart enough to come up with some way to keep the hazard of the waste as minimal as possible," said Karen J. Wheeless, Energy Department public relations officer in Richland, Wash.

Certainly in the developing science of nuclear waste isolation, no one can offer iron-clad guarantees. In the absence of a quick fix, probabilities must suffice.

"Unavoidable adverse impacts will be mitigated to the extent practicable," said the Energy Department's 1984 Mission Plan for planning and building the repository that could be built at Hanford.

Charles B. Hunt, an American Geological Institute former executive director who participated in initial meetings 30 years ago on radioactive waste disposal, is concerned that such standards aren't good enough.

"Back in the 1950s, the question arose of how much leakage could be tolerated," Hunt said. "The best definition that a group of geologists from all over the country could come up with was 'Enough radiation to kill a tortoise, but not enough to kill a jack rabbit.'

"I don't think the specifications are any better today. In terms of the length of time that's involved here, a spill is as certain as Three Mile Island."

U.S. Environmental Protection Agency officials are working to develop repository release standards in what they admit is not the best of all possible worlds.

"The best repository site would have the geology of granite, the geochemistry of basalt, the hydrology of salt, the radionuclide retention of shale," said W. Alexander Williams, an EPA chemist. "There's no such animal."

Waste disposal plans

TOR
MAY 26 1985
Pg 3 of 11

Uncertainties surround plans to dispose permanently of each category of radioactive waste in the United States.

Here is a summary of government plans for each type and a sampling of critics' complaints.

— Richard Read

Mill tailings

The earthen residue left from mining the raw material for nuclear fuel will be moved to areas expected to be stable for at least 200 years. The tailings will be placed away from water bodies and covered with an earthen cap to contain radiation and prevent erosion.

Representatives of the depressed uranium industry are suing the federal government, claiming disposal standards are too stringent, and environmentalists are suing in the belief the standards are lax.

At an old mill site north of Lakeview in southcentral Oregon, 5.7 million cubic feet of tailings, contaminated soils, existing pile cover, evaporation ponds and adjoining properties fouled by windblown contaminants will be moved seven miles north for stabilization, if the Energy Department has its way.

Responses are due by June 3 to a department environmental assessment that called for a $12 million project to transfer the material to the Collins Ranch.

Spent fuel

The U.S. Department of Energy wants to move spent nuclear fuel from temporary holding pools in the nation's 88 operar ; commercial power plants and ; ce it in interim storage, beginning in 1989. The Tennessee site that had been proposed for the Clinch River breeder reactor has been proposed for this "monitored retrievable storage."

The Energy Department plans to build two deep geologic repositories for ultimate disposal of the highly radioactive material. Tentative finalists for the first repository are at the Hanford Nuclear Reservation in Southeastern Washington, Yucca Mountain in Nevada and Deaf Smith County in Texas.

Periodically, reprocessing of commercial spent fuel has been urged. It would extract uranium for reuse in generating power and could also be a source for plutonium for nuclear weapons.

Spent fuel from Hanford's N Reactor was sent to a commercial plant in West Valley, N.Y., for reprocessing along with civilian waste at a Nuclear Fuel Services Inc. plant. The plant shut in 1972, however, because the company said it could not meet environmental standards, said Ted DeBoer, a New York Energy Research and Development Authority official.

Taxpayers must now pay $472 million to remove 560,000 gallons of liquid from a tank and melt the liquid into 300 glass "logs" for burial in the national repository.

"The quicker we get it out of there the better, because you never know when tanks will leak," said DeBoer, whose agency monitors the federal program, now called the West Valley Demonstration Project.

High-level

Much of the nation's highly radioactive defense waste also will be melted into glass "logs" about 18 inches in diameter, according to the Energy Department.

The 10-foot-long logs will be encased in stainless-steel cylinders and buried in a repository, perhaps the same one used for commercial fuel.

A large "glassification" plant is being built at the Energy Department's Savannah River Plant near Aiken, S.C., and another is proposed at Hanford.

Other high-level waste residue, which the Energy Department believes too expensive and dangerous to move, may be left in tanks beneath a blanket of riprap at Hanford, despite critics' claims that the plan would be unsafe.

Transuranics

Some of the government's refuse contaminated with long-lived isotopes is expected to go to the Waste Isolation Pilot Project in New Mexico, which is being built 26 miles east of Carlsbad. Critics claim the repository is not safe.

Other defense waste deemed by department officials too dangerous and costly to dig up would be stabilized and left in place.

The future storage location of commercial transuranic waste is undecided.

THE OREGONIAN
Portland, OR
MAY 26 1985

Low-level

At the urging of Washington, Nevada and South Carolina — the three states with operating commercial dumps for low-level wastes — Congress passed a law in 1980 instructing states to form compacts establishing new regional low-level dumps. Officials in the three states were tired of accepting all of the nation's commercial low-level waste, and the resulting law said any states taking part in a compact could exclude non-members from its site beginning next January.

A Northwest compact, awaiting congressional approval, would include Oregon, Washington, Idaho, Utah, Montana, Alaska and Hawaii. Those states would continue to send their garbage to Hanford's commercial U.S. Ecology Inc. dump, where users are charged a fee to create a fund for long-term maintenance and monitoring.

But so far, no new dumps are near establishment, and several of the biggest waste-generating states have not approved plans for compacts, resulting in a deadlock. South Carolina Gov. Dick Riley has threatened to close that state's dump.

Meanwhile, officials in Kentucky, Illinois and New York continue to survey contaminated water leaching from closed dumps in those states. Overflowing trenches are pumped dry, generating large volumes of radioactive water that must be evaporated.

Airborne

Releases have been limited by new Environmental Protection Agency standards, which the agency established at the demand of a court order obtained by the Sierra Club.

Environmentalists say the standards are too low, however.

Old N-plants

Rules proposed by the U.S. Nuclear Regulatory Commission would state that within two years of closing a nuclear plant, a utility should submit logistical and financial plans for decontamination. Utilities could either clean up their plant immediately; wait to scour the plant until radioactivity levels fell; or entomb the plant in a material such as concrete.

Highly radioactive waste would be turned over to custody of the Energy Department, and low-level waste would be shipped for shallow burial in commercial dumps. Critics worry that fluids left from cleaning the plants would become dangerous, highly mobile radioactive wastes in their own right.

World seeks solutions to waste problem

TOR
MAY 26 1985
Pg 5 of 11

By RICHARD READ
of The Oregonian staff

No deep geologic repository is operating anywhere in the world to isolate highly radioactive waste from the environment, American experts say.

"I would guess the Germans have a good chance of getting one in operation first," said Kent M. Harmon, a Battelle Pacific Northwest Laboratories expert on international waste. West Germany stores its spent fuel temporarily in cast-iron casks and has begun drilling a shaft into a salt dome for a repository that could accept waste in 1995 if tests prove positive.

The 11 foreign countries committed to reprocessing civilian spent fuel face a greater technical challenge than the United States in isolating civilian refuse. Reprocessing extracts uranium-235 from spent fuel to be reused in reactors, but it leaves behind highly radioactive liquid waste that must be solidified to make it easier to contain.

Foreign countries run the gamut in their commitment to nuclear technology and in their efforts to manage and dispose of atomic refuse.

At one end of the spectrum, France plans to gain 70 percent of its electricity from nuclear power by 1990 and to expand nuclear reprocessing activity. At the other, Sweden plans to shut all its nuclear plants by 2010, as the result of a national referendum in 1980.

France is building a full-scale plant to solidify liquid reprocessing wastes into borosilicate glass. The French by 1987 plan to choose a repository site in salt, clay or crystalline rock, which is rock like granite made up of minerals with geometrically arranged atoms. A pilot plant already has "glassified" some waste, but a French government panel of experts warned in 1982 that the glass — which is fundamentally the same material planned for similar use in the United States — would dissolve too quickly to be counted upon for anything more than temporary storage.

"This glass is being stored in air-cooled tubes in a concrete structure at ground level," said Alex F. Perge, special assistant to the director of the U.S. Department of Energy's office of civilian radioactive waste management integration division. The French glassification pilot plant has experienced operating accidents, said Marvin Resnikoff, co-director of the Sierra Club's radioactive waste campaign. A similar plants is being built in West Valley, N.Y.

Sweden, which is storing its spent fuel temporarily in a granite cavern, plans in 1988 to begin low-level waste disposal in the crystalline rock floor of the Baltic Sea and to build a repository in crystalline rock.

"Sweden is much more sensitive to releasing waste into the repository than we are," said Roger E. DeWames, a Rockwell International physicist in Thousand Oaks, Calif. Contrary to American plans to rely heavily on natural rock for waste containment, Swedish officials plan to sheathe glass waste "logs" in lead and titanium and to enclose their spent fuel in copper.

Japan, which reprocesses fuel and plans to operate breeder reactors by 2010, is the only country to have considered mining a repository in basalt, as the United States may do at Hanford, Harmon said. The Japanese plan storage of waste canisters for as long as a century, and many other countries plan to allow waste radioactivity to decay in interim storage while planning repositories in crystalline rock, salt, clay or shale, he said.

Many other countries have used a narrow technical approach compared to the United States, picking one rock type or waste-handling procedure to research and develop, rather than studying the realm of possibilities, Harmon said.

"They've used the rifle approach rather than the shotgun approach," he said. "As a result, in some cases they're ahead of the United States in technology."

In Switzerland, citizens successfully pushed the government to shut down the country's nuclear plants by the end of the year if utilities cannot guarantee an ability to isolate waste. Scientists are examining crystalline rock and plan one repository for high-level waste and another for less potent forms.

"The waste management issue is often seized upon by opponents of nuclear energy as a weak point in the system," said Harmon, who believes long-term safe isolation of nuclear waste is feasible. In Denmark, where public opposition has postponed introduction of nuclear power several times, researchers already are ahead of the United States in exploring deep geologic disposal sites.

Many countries perceive disposal of low-level radioactive waste as their most pressing nuclear waste problem, principally because of the large volumes involved and the difficulty of siting dumps, Harmon said. An international conference will be held in September to determine what would result from resuming the practice of dumping low-level radioactive wastes directly into the ocean, he said.

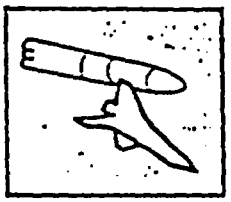
The Soviet Union and other Eastern bloc countries are evaluating a range of rock types as hosts for a repository, and the Soviets have pilot plants that enclose waste in borosilicate and lead phosphate glass. Australia is a leader in research on immobilizing waste in synthetic minerals.

The Canadians are building an underground laboratory in granite near Whiteshell Center, Ontario. Brazil is considering stashing waste on deserted islands off the coast.

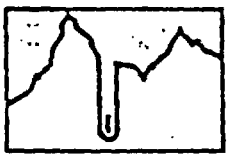
THE OREGONIAN
Portland, OR
MAY 26 1985

Future solutions?

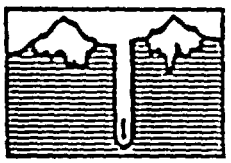
Scientists trying to solve the nation's vexing nuclear waste problems have devised some unusual solutions, including delivering radioactive refuse to an uninhabited island. Here are some of the ideas considered for disposal of spent fuel, high-level radioactive waste and transuranic waste:



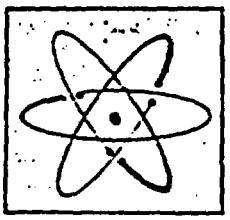
Extraterrestrial disposal. The National Aeronautics and Space Administration has considered using the space shuttle to carry radioactive waste into the heavens, an option that could require 250 launches annually by the year 2000. Various government studies have examined possibilities of propelling atomic garbage into orbit around the Earth, shooting it into the sun, landing it on the moon, crashing it into planets or ejecting it from the solar system altogether. Proponents have been discouraged by steep costs, high energy consumption and the potential for crashes on this planet.



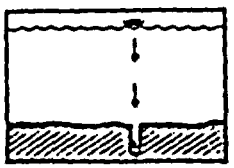
Ice sheet disposal. The Greenland and Antarctic ice sheets have been nominated as nuclear dumps. Ice-breaking ships, planes and vehicles would carry the waste to remote reaches. Canisters would then be allowed to melt deep into the ice by virtue of their own heat, either reaching bedrock in five to 10 years or hanging at the end of 1,000-foot cables. The harsh environment and lack of knowledge about ice sheets are considered drawbacks.



Continental disposal. Scientists have considered stashing waste in "super deep" holes, perhaps down to 60,000 feet below ground surface. They have suggested injecting it into deep wells. They have toyed with the idea of letting it melt its way into the Earth's crust, eventually bonding with deep rock. No one knows how to drill holes that deep, however, and even less is known about how waste might behave in wells or descending through rock.



Transmutation. Scientists have long fancied converting hazardous radioactive materials into short-lived, innocuous substances by bombarding them with atomic particles by machine or using nuclear detonation. Eleven detonations of 100 kilotons per year could accomplish that for the waste of each 1,000-megawatt reactor, but the U.S. Environmental Protection Agency says it is "not likely this method would be considered acceptable." Fission or fusion reactors could someday do the job given technology breakthroughs, and although particle accelerators could accomplish the task, more energy would be consumed than would be produced making the waste.



Sub-seabed disposal. Most of the $11.5 million being spent by the Energy Department in 1985 on research into alternative disposal concepts went toward the idea of sinking waste into mud blankets on the ocean floor. Several areas in the Pacific and Atlantic oceans have been identified as attractive dump sites. Proponents say canisters could be dropped like darts into the soft sediments, which would close in around the waste and chemically trap radioactive substances.

Source: U.S. Environmental Protection Agency.

TOR
MAY 26 1985
Pg 7 of 11

Hanford plans for cleanup of complex

Even if the nation's first nuclear fuel repository does not come to Hanford and attract thousands of truckloads of waste annually, hundreds of containers of another form of radioactive waste are scheduled to leave the reservation bound — likely in many cases over Oregon highways — for New Mexico.

The "massive" shipping effort, expected to begin by 1989 and take 25 years, involves Hanford trash contaminated with transuranic — or long-lived — radioactive substances, said Michael H. McFadden, U.S. Department of Energy transuranic program manager in Albuquerque, N.M.

The transuranic waste destined for the Waste Isolation Pilot Project repository 26 miles east of Carlsbad, N.M., is just one type of refuse that must be cleaned up as Hanford attempts to improve on temporary waste storage.

"We're trying to break with past history and move toward ultimate disposal," said Jerry D. White, Energy Department waste management director in Richland, Wash.

No firm estimates are yet available of the number of truck, train or barge loads that will be required to move 548,000 cubic feet of Hanford's transuranic waste to New Mexico.

But container capacity figures show more than 800 truckloads would be required to carry just the waste itself, let alone its packing material, and a minimum 2,400 truckloads would be necessary to move similar waste from the Idaho National Engineering Laboratory near Idaho Falls.

Internal Energy Department papers say additional Hanford transuranic waste may be melted into the ground.

The documents acknowledge many unresolved technical issues, but they recommend a $4.5 billion cleanup of the reservation, in which:

- Underground tanks containing 31.5 million gallons of highly radioactive sludge would be covered with rocks and markers.

The residue in the 149 tanks remains from Energy Department efforts to halt leaks by evaporating liquid, and now officials want to save $6.5 million and spare workers radiation exposure by leaving the sludge in place.

The Natural Resources Defense Council, an environmental group in Washington, D.C., says the plan is unsafe and would violate a 1982 federal law requiring that highly radioactive civilian and defense waste be buried in a deep repository.

> "We're trying to break with past history and move toward ultimate disposal."

Hanford's White maintains the defense waste in the 149 single-walled tanks is less dangerous than civilian waste in the same classification.

- Highly radioactive waste in Hanford's newer, double-walled tanks would be melted into glass and moved to a repository.

Critics say the glass is not the best material to contain waste, but Energy officials say it's perfectly adequate.

- Contaminated soil beneath 330 cribs, trenches, wells and ponds would be stabilized with fill.

Hanford officials say preliminary data indicate highly contaminated ground water would not reach the Columbia River, but critics are skeptical.

- Hazardous chemicals would be evaluated later for disposal.

The state of Washington is trying to force a halt to the practice of dumping into the soil liquid waste that is hazardous both because of its chemical contents and its radioactivity.

But the Energy Department has maintained it has exclusive jurisdiction over radioactive waste.

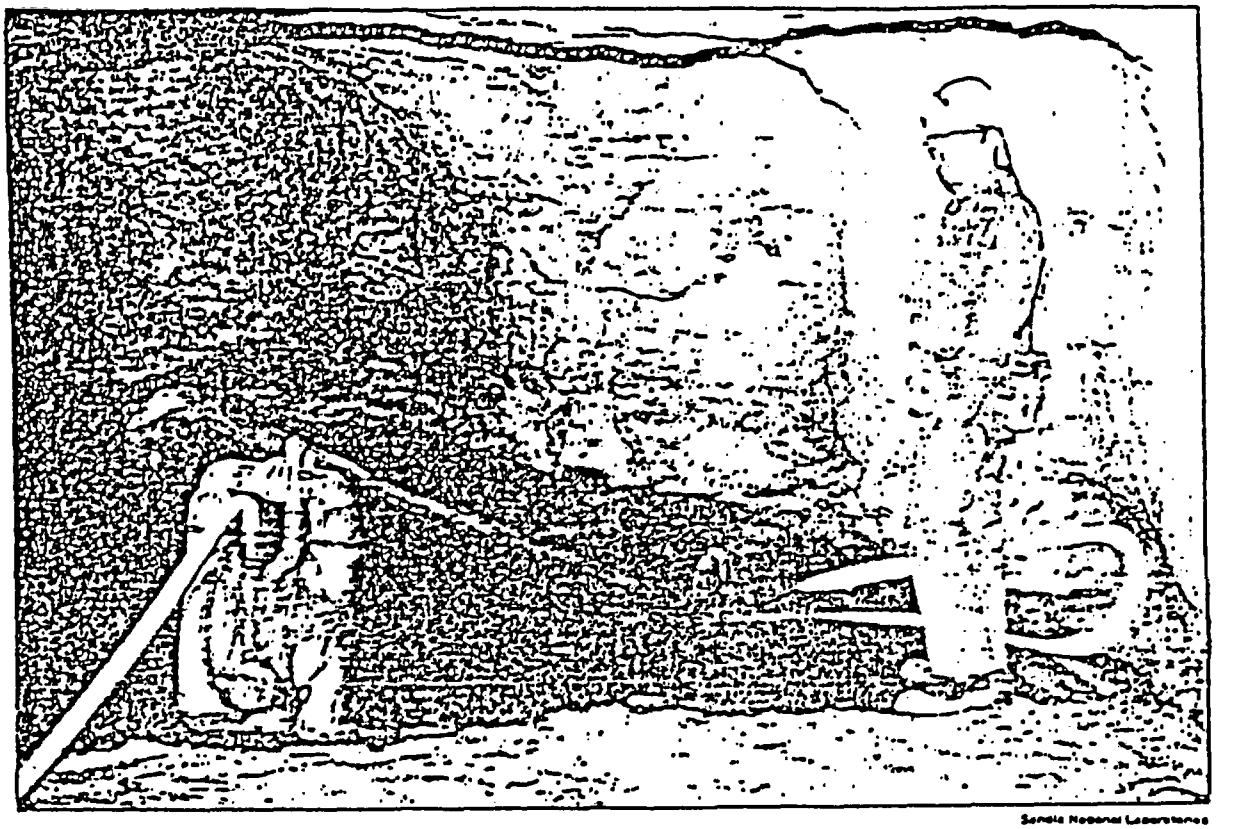
The health and environmental effects of the entire cleanup alternative and other disposal options are being analyzed by Battelle Pacific Northwest Laboratory.

The resulting draft environmental impact statement was to have been released this month, but the Energy Department delayed the publication date until August after rating Battelle's efforts as "weak."

THE OREGONIAN
Portland, OR
MAY 26 1985

The Hanford gamble: No quick fix

New Mexico mining fails to drown out safety debate



Sandia National Laboratories

FLOODED TOMB — Art Moss, engineering geologist for government contractor D'Appolonia Consulting Engineers, stands by pump removing water from the nation's first nuclear repository, the Waste Isolation Pilot Plant in New Mexico, which is intended for defense waste.

By RICHARD READ
of The Oregonian staff

If both sides of a bitter technical controversy surrounding an atomic tomb being built in New Mexico agree on one thing, it is that their experience shows that the din of mining a repository at the Hanford Nuclear Reservation would not silence safety arguments.

Contaminated trash destined for the crypt under construction typically emits far less heat and penetrating gamma radiation than the highly radioactive waste that would come to Hanford if the U.S. Department of Energy built a nuclear tomb there.

Disagreement among scientists familiar with the Waste Isolation Pilot Plant near Carlsbad, N.M., shows that the Energy Department is willing to build a repository in the face of lingering logistical doubts and technical criticism.

"On almost any societal issue there are some people who are just opposed to things," said Wendell D. Weart, nuclear waste technology department manager for Sandia National Laboratories.

Sandia is responsible for testing the safety of the $1 billion tomb for the Energy Department's transuranic trash contaminated with long-lived radioactivity.

Transuranics are solid materials contaminated so that radioactivity levels are at least 100 nanocuries per gram, or 100 times the radioactivity of uranium ore.

Transuranics are long-lived, and they emit alpha radiation, which is harmful if the radioactive substance is ingested. (A nanocurie is one billionth of a curie, a measure of radioactivity.)

"I think the more we learn, the better confidence we have in the processes that occur at the site," Weart said, noting that large amounts of refuse would not be accepted until Congress certified the repository following waste-emplacement tests beginning in 1988.

Jack M. Mobley, liaison officer for the Environmental Evaluation Group, a state agency that uses federal money to monitor site research and development, noted that far less would have been learned about the project already 11 years in the making had not New Mexico threatened the federal government with a suit in 1981.

Pending further research, which is being conducted at the state's prodding, the jury is still out on both the long-term and short-term safety of the repository in the 1,500-foot-thick Salado formation, Mobley said.

"The more we know about WIPP, the less good the site looks, and that's a

TOR
MAY 26 1995
Pg 9 of 11

A case study

While the nation struggles to send its most dangerous radioactive waste to a final resting place, the U.S. Department of Energy is taking steps to deal with another form of nuclear refuse — transuranic trash.

Transuranic waste has hazards presenting different challenges than the hot, highly radioactive spent nuclear fuel that could end up in a deep crypt at Hanford. But experts inside and outside the Energy Department regard the transuranic defense waste disposal program as one indicator of the way the agency will handle the civilian program for disposal of spent fuel. Critics worry about some of the signs they see.

In confronting its transuranic waste, the Energy Department quietly redefined the refuse, which cut the quantities to cope with, and it has promoted a repository that continues to receive technical criticism.

real bad sign," said Don Hancock, director of the Southwest Research and Information Center, an environment and health research and advocacy organization in Albuquerque, N.M.

Some of the most troubling information on the repository site was unearthed by former Sandia geophysicist Lawrence J. Barrows while he worked for Weart in 1981.

Barrows, who recently left Sandia to work for Lockheed Engineering and Manufacturing in Las Vegas, Nev., studied the geologic and hydrologic characteristics of the site.

"We got indications of karst conduits in the Rustler formation," Barrows said.

Karst is a geologic term for corrosion-caused rock cavities, dramatically enlarged versions of which are viewed daily by tourists nearby in the renowned Carlsbad Caverns.

The Rustler formation is a rock layer that overlies the repository's Salado layer, and Barrows thinks such cavities in the Rustler formation could allow contaminated ground water to move much faster from a repository to the environment than researchers have assumed.

"This should have been confronted years ago, and they're only now beginning to work on it," Barrows said, claiming that Sandia was unreceptive to his findings.

"It's been a problem throughout the radioactive waste game. They'll select a site, and then they'll proceed to determine the characteristics, so you're sort of stuck with what you've got," he said.

Weart said Barrows was a competent geophysicist, but not not a karst specialist. Points raised by Barrows and other critics have been thoroughly examined and discounted by scientists who specialize in such matters, said Weart, a geophysicist.

"So far, we have found absolutely no indication that karst exists at the site," Weart said.

Karst found nearby does not lie southeast of the site in the expected path of initial ground-water flow, he said, disputing critics' contentions that ground water would carry contamination more directly to a nearby lake.

But Richard H. Phillips, a geomorphologist who is studying the waste isolation plant in preparation for writing a doctoral thesis at the University of Oregon, said he and Barrows had been barred from meetings held to discuss the karst studies.

"The most blatant karst features have been gerrymandered out of the WIPP site," said Phillips. He maintained — contrary to Weart — that an alteration of the WIPP site's boundaries has excluded a drill hole that penetrated karst just 2½ miles west-northwest of the repository shaft.

Phillips said contaminated water could take only decades to reach plants and animals, instead of more than 100,000 years as Sandia estimated. A pressurized brine pocket discovered in 1981 already led to relocation of waste disposal rooms more than a mile south and could well provide the drive to push contamination to the ground surface, he said.

"Brine in a hole one mile north of WIPP is of sufficient volume that it is extremely likely the reservoir extends underneath the center of the repository," Phillips said.

Roger Y. Anderson, a University of New Mexico geology professor, agreed with Phillips, noting brine has shot out of exploratory holes. Salt in the reservoir, which is thought to contain several million barrels of brine, may be the same salt that mysteriously dissolved at some time from the lower part of the Salado formation, said Anderson, who is on sabbatical doing research for the U.S. Geological Survey in Menlo Park, Calif.

"There's a lot of salt missing," Anderson said. "The dissolution favors the same level as where the repository is.

"Somehow, water could get into that layer and get out again, and so far no one has been able to explain the pathway."

Weart said drill tests have not found that kind of dissolution at the site. He said the brine pocket has not been proved to extend beneath the repository, and even if it did, calculations showed "benign" radiation doses from a worst-case scenario in which future miners drew contaminated water to the surface.

Researchers are in a "Catch-22," however, Weart said, because they do not want to explore for the brine pocket for fear of connecting it to the repository if it exists.

Phillips said he doubted the ability of the Energy Department to seal the shaft leading to the repository; he said water already seeped into the cavern from shaft walls when workers turned off ventilators.

Weart said the water seepage existed but was minimal.

"The amount of water that enters WIPP now is so small that it's almost silly to even consider it," Weart said. "At one time there was a puddle I could walk through with my shoes on, so it was probably a few inches deep. That's the most we ever had in there."

As the argument continues, a National Academy of Sciences panel has suggested items for additional research but fundamentally has approved of the integrity of the repository. The project has been "much less ham-handedly handled" than earlier attempts to find permanent atomic dumps, panel staff director John T. Holloway told Science magazine.

New Mexico Environmental Evaluation Group officials have certified the repository for initial limited receipt of 6 million cubic feet of transuranic waste, although the agency continues to push for resolution of 12 technical questions.

THE OREGONIAN
Portland, OR
MAY 26 1985

Transuranic waste redefined as low level

Without a public hearing, the U.S. Department of Energy last year issued a national internal order converting as much as a third of its trash contaminated with long-lived radioactivity into low-level radioactive waste.

The redefinition of transuranic waste means enduring radioactivity in the garbage will be left to decay in shallow burial alongside refuse fouled with lesser forms of radioactivity. Before the order, the transuranic waste would have had to be completely isolated from living things in a 2,150-foot-deep crypt being built in New Mexico.

The redefinition, coupled with revised inventories that second-guessed historical waste disposal records held to be inaccurate, cut the Hanford Nuclear Reservation's inventory of buried transuranic waste by more than half, according to an Energy Department report. The waste contains heavy elements such as plutonium and americium, some of which will remain radioactive for millions of years.

Preliminary national estimates indicate national inventories of transuranic defense wastes were cut between 10 percent and 30 percent by the redefinition, said David B. Leclaire, director of the Energy Department's defense waste and byproducts management office. The Feb. 6, 1984, order contained the one-sentence redefinition as the 27th item on a list of terms.

"When you set these standards, you have to consider these tradeoffs," said Anthony F. Kluk, a health physicist in Leclaire's office. "One aspect is, how much are we willing to spend to dispose of this waste and is the expense justified? We couldn't see that there was a great enough hazard to warrant maintaining the level of 10 nanocuries per gram."

Transuranic waste originally was defined as solid material — such as dirt, sludges and filters — contaminated with more than 10 nanocuries per gram of long-lived radioactive substances that emit alpha radiation. Alpha radiation cannot penetrate skin, but it is extremely harmful if the emitter is ingested. A nanocurie is one billionth of a curie, which is a unit of radioactive decay equal to 37 billion atomic disintegrations per second.

The original definition was developed in 1970 after waste was detected leaking from a flooded dump at the Idaho National Engineering Laboratory near Idaho Falls, Kluk said. Idaho officials complained, and the federal government resolved to stop burying transuranic waste, to segregate it on asphalt pads and to send it eventually to a repository, he said.

The original definition was developed to include material with at least 10 times the natural concentration of radioactivity in uranium ore, Kluk said. But the new definition moved the minimum concentration up to 100 nanocuries per gram, or 100 times the radioactivity of uranium ore. It also deferred the time of measuring the radioactivity to a century after the material's packaging as waste.

"There's not a specific break there in the hazard really at that point, it's just that that's a convenient place to set the levels," said Kluk, who added the decision was more one of policy than of science. Moving the less-contaminated waste to a New Mexico repository might create a lot of jobs, but it would waste money, he said.

"We did look extensively at the hazards associated with waste contaminated up to 100 nanocuries per gram, and we found there would be no hazards associated with shallow land burial," Kluk said.

The health and environmental impacts of a redefinition were the subject of a scientific conference in 1982 in Washington, D.C., and various scientific groups were consulted, Kluk said.

No public hearings were held, and no notice was placed in the Federal Register, he said.

"We've gotten comments in from the public, and we've answered those," Kluk said. Kluk's subsequent check showed his office received a total of three letters from the public mentioning the change.

The U.S. Nuclear Regulatory Commission was consulted along with other federal agencies, however. Asked whether the Energy Department made the change in order to get rid of large quantities of transuranic waste, Michael J. Bell, Nuclear Regulatory Commission waste management division deputy director, said: "I'm sure it was a consideration."

Tom Bauman, Energy Department public affairs officer in Richland, Wash., said no one would know how much transuranic waste was cut from Hanford's inventory because of the redefinition until a new machine can be brought on line to measure radioactivity concentrations. But the department's annual list of national waste quantities — issued in September — said a 6.7 million-cubic-foot inventory of buried waste fell by 3.5 million cubic feet because of the redefinition and revisions of historical dumping records.

J. Andrew Detamore, a Rockwell research engineer in the transuranic waste program management group in Albuquerque, N.M., said old Hanford inventories recorded at the time of disposal were judged inaccurate.

"The earlier figure was more of a wild guess than anything," Detamore said. "From looking at waste streams and estimating what previous operations would have generated, they've come up with a much better estimate of what is out there."

TOR

MAY 26 1985

Pg 11 of 11

Politics, economics edge out safety

Safety — the major issue in finding a spot to bury spent nuclear fuel — comes behind politics and economics when those working in the energy industry begin talking about nuclear power in America.

Nuclear power helps keep the United States from becoming too dependent on imported oil for power, said Scott W. Peters, media services manager for the Atomic Industrial Forum, a nuclear-power trade association with headquarters in Bethesda, Md.

"If we want our economy to continue to improve, we've got to have electricity. It's a vital part of our energy mix," Peters said.

Peters noted that the country's 88 commercially operating nuclear plants produce about 13 percent of the power used in the United States, a figure he expects to grow to 19 percent when 33 other plants that are under testing or construction are in use.

Peters' assessment of nuclear power's role in the U.S. energy picture is disputed by Amory Lovins, a Colorado physicist and energy consultant. He is director of research at the Rocky Mountain Institute, a non-profit firm that is a consultant for a variety of firms and agencies, including the Bonneville Power Administration.

To Lovins, nuclear power is just too uneconomical to use. He favors conservation and alternative energy sources.

"It generally costs less to save electricity than to generate the same amount at a nuclear plant," he said. "That's assuming that you're paying just the operating costs, and you're not paying the capital costs at all."

In addition, Lovins said, nearly 40 percent of the electricity supplied by nuclear plants goes for uses that would be served more economically in other ways, like space and water heating.

"If the technology is uneconomical and unnecessary, we don't need to argue about whether it's safe," Lovins said.

Peters, however, doubts that conservation could make up for the electricity that would be lost if nuclear plants were shut down.

He points out that the cost of generating power at a new nuclear plant is about equal to that at a coal plant, 3.5 cents per kilowatt-hour. That compares to a cost of 6.5 cents if oil is used.

When commercial nuclear power got started in the 1960s, it was cheaper than other sources of electricity. Then came the lowered power demands and higher interest rates of the 1970s recessions. Those factors, and regulatory delays caused by environmentalists, drove up the costs of nuclear plants, Peters said.

"Unfortunately, nuclear power was born in a bomb," Peters said of anti-nuclear sentiment.

For instance, the cost of the controversial Diablo Canyon Nuclear Power Plant near San Luis Obispo, Calif., rose from $2.3 billion after required safety modifications to $5.6 billion by the time it became fully operational this month.

Washington Public Power Supply System Plant 2, on the Hanford Nuclear Reservation, cost $3.3 billion to complete, though the initial cost estimate had been $400 million. Lowered power demands and high interest rates both played a role in the collapse of the supply system's one-time plan to build five nuclear plants.

Lovins agrees with Peters that regulatory delays have helped drive up the costs of building nuclear plants, but he says that is because of a built-in political problem: People demand better environmental performance from any industry as time goes by.

With nuclear reactors, "Each one has to be perceived to be safer," he said. "The hazard per plant has to go down."

"The more plants are built, the more likely it is that one of them will be near you, and the more pressure you'll put on the regulators to stiffen the standards," he said.

For those reasons, the costs of nuclear power will continue to rise, he predicted. He noted that no new nuclear power plants have been ordered since 1978 because of high costs in the face of uncertain power demand.

Peters remains optimistic about nuclear power's future and technology's ability to safely isolate the waste deep underground.

"If we're going to continue with this nuclear power," he said, "we have to continue getting rid of waste. It has to go somewhere."

A summary

Over 15 days, The Hanford gamble has covered a wide variety of topics related to the proposal for a nuclear-fuel tomb at the Hanford Nuclear Reservation. Here are some of the highlights:

- Begun in World War II, the nation's nuclear work has resulted in a wide variety of radioactive waste, much of which has not been disposed of permanently.
- The Hanford Nuclear Reservation already is by some measures the world's largest known nuclear dump. Adding a burial site for 77,000 tons of spent nuclear fuel would make it indisputable king of the nuclear dumps.
- The Tri-Cities near Hanford provide a staunchly pro-nuclear community eager to take on more federal contracts.
- Serious doubts remain about the ability of basalt rock at Hanford to keep a spent-fuel dump from contaminating the Columbia River, which would be four miles from the repository.

Critics wonder if doubts about the site can ever be alleviated.

- Most of the spent-fuel rods that would be buried at Hanford are in the eastern United States. Trucks carrying spent fuel would travel 1.1 million miles over Oregon roads and 157,000 miles in Washington to get to Hanford.
- The debate over the effect of radioactivity at Hanford on the Northwest is hampered because no independent studies of radiation effects have been done. In addition, a vocal minority of scientists disputes Energy Department conclusions that radiation effects on Hanford workers have been minuscule.
- When the search for a spent-fuel repository became official in 1983, Hanford already had a leg up on its competitors because it had been studied since 1968. The reason for continuing to study it was the federal government's ownership of the land.
- Washington state government ignored Hanford and its effects on the region for years, until the repository process beamed a spotlight onto the reservation. Oregon, too, only recently started to look at the dump proposal.
- More than half of the $605.4 million spent since the formal process began has gone to two contractors. Critics say the big money to be earned could skew the siting process.
- Critics say that a hidden agenda of looking to bury spent fuel at Hanford is the future possibility of reprocessing the fuel to extract plutonium for nuclear weapons.

benefit to the average Oregon family, whose median income is $24,516. The impact of a 5 percent sales tax on top of an uncontrollable property tax in a stagnant Oregon economy is negative.

WILLIAM R. BRICE,
3678 S.E. Woodstock St.

Received two gifts

To the Editor: I got two early Mother's Day presents this year. One was Judith Barrington's superb essay, "Not every woman need be a mother" (May 10). I've been one for nearly 30 years and I read everything about mothers. This is the first article that equally honors me and my sister, Grace, who chose not to have children.

The other present is the news that one of my children was finally arrested for civil disobedience rather than for shoplifting or brawling. Shoplifting and brawling; are my children hoodlums? Far from it. And yet, among my four fine children and their friends, I have seen suicide, attempted suicide, alcoholism, drug addiction, shoplifting, depression, cult dependency, despair and cynicism.

The suicide rate has quadrupled among young persons in the last 25 years. Addiction rates are skyrocketing. The economy teeters. The gap between rich and poor is growing. Unemployment among minority youth exceeds 75 percent in some places. The shadow of a mushroom cloud hangs over a planet being stripped and poisoned.

Our leaders? Sometimes they remind me of little boys standing up to their knees in gasoline fighting over who has more matches.

I have seen the despair of our young people. I have also seen their hope, their zest for life, their creativity and their determination to create a better world.

Our daughter, Sarah, a 1981 Lincoln graduate, was arrested May 7 in Springfield, Mass., for blocking the entrance to a federal building. She and 200 others were protesting the economic sanctions our government has placed on Nicaragua. I am as proud of her for that as I am that she will graduate with honors from Mt. Holyoke College May 26.

BETTY McFARLANE,
1000 N.W. Winter Lane.

Data not filtered

To the Editor: As non-management members of the technical staff of Rockwell Hanford Operations, whose responsibility was integration of the draft environmental assessment for basalt, we question the unfounded accusations made in your article, "The "Hanford gamble" (May 16).

We know of no instance where management filtered or otherwise manipulated any of the data used in the draft environmental assessment. Indeed, in light of the goldfish-bowl environment we live in at Rockwell, where the raw data are available to all who ask, such a notion is inconceivable. The document reviewers were given the assignment to assure that this complex 1,200-page, multidisciplinary document met the highest scientific standards.

Our role was to attempt to eliminate unwarranted or inappropriate conclusions resulting from an insufficient or otherwise inadequate data base; eliminate or identify conjectural statements; attempt to identify clearly the degree of uncertainty associated with data, analytical methods and conclusions; and clearly identify alternative or contrary technical viewpoints about any given data set.

The reviewers had thoroughly reviewed prior criticism of the Basalt Waste Isolation Project resulting from the Site Characterization Report to sensitize them to the concerns of external technical reviewers. Finally, it was the reviewers' assignment to assure that technical criticisms of parts of the early drafts of the environmental assessment made by non-Rockwell external peer reviewers drawn from the technical community had been explicity addressed by the draft study's authors.

It was our professional responsibility to assure that the draft assessment was indeed a technically balanced document. Although there are legitimate differences of opinion on the interpretation of some elements of technical analysis in it, such matters can only be resolved by site characterization.

We feel that we met the goals and responsibilities of providing an in-depth review of the draft environmental assessment. A careful analysis does not support the accusation by Rich Read of your staff that "Rockwell officials have a longstanding practice of playing up supportive data while de-emphasizing negative findings," or that any data generated by staff or subcontractors are being filtered by either the project technical staff or its management.

HARRY BABAD,
and 4 co-signers,
Rockwell Hanford Operations,
Richland, Wash.

Tests must be valid

To the Editor: The editorial, "Teacher, teach thyself" (May 16), praises Mary Hatwood Futrell, president of the National Education Association, for her support of competency tests for new teachers, then goes on to attack the Oregon Education Association for "fighting off" House Bill 2466, which requires new teachers to be tested prior to certification and existing teachers to participate in continued professional training in order to renew teaching certificates.

As OEA testified before the House Education Committee April 9, OEA is not against new teacher testing as long as the test is valid, done by the individual states at the college or university level, and is only one of the criteria for certification.

Contrary to your editorial opinion OEA does believe that all teachers should be competent and that the quality of teaching in public schools is of the utmost importance. Over the years, the association has lobbied for better evaluation laws and higher standards for teachers. We firmly believe that continued professional training is important for all teachers.

However, HB2466 fails to address the problem of how teachers can reach these special training programs. School districts are not guaranteed funding to provide them; therefore, teachers may be forced to leave their homes for eight weeks a year to learn in a centralized location. Also, HB2466 makes no provisions for tuition.

Your editorial suggests that OEA has a lot to learn at this summer's NEA national convention. I submit that your editorial writer also come and get the facts.

JAN H. HAMLIN,
Oregon Education Association,
6900 S.W. Haines Road,
Tigard.