To: Robert E Browning MS 623 SS

HANFORD

A NATIONAL NUCLEAR WASTE REPOSITORY ?

A Citizens Guide to Key Issues

WASHPIRG

The Washington Public Interest Research Group

February 19, 1985

EXECUTIVE SUMMARY

A growing controversy has surrounded the proposed siting of a national high-level nuclear waste repository at Hanford, Washington. In December, 1984, the Hanford site was officially nominated by the U. S. Department of Energy (USDOE) as one of three potential locations along with the Yucca Mountain area in Nevada and Deaf Smith County in the Texas Panhandle.

Research on Hanford's suitability as a waste repository has been under way since the mid-seventies, well before 1982 Federal legislation mandating a selection process and timeline for a national repository by the year 2000. Since 1982, more focused attention has been directed at specific conditions at and around the Hanford site.

WashPIRG has monitored the potential repository at Hanford since 1978 and has published reports outlining public interest concerns with such siting. In December of 1983, WashPIRG released High-level Nuclear Waste At Hanford: A Geologic Critique, in which the USDOE was urged to disqualify Hanford from further consideration as a potential repository. This position was based on a scientifically defensible analysis of existing geo-hydrologic research.

WashPIRG researchers have now reviewed the Draft Environmental Assessments published by the USDOE, and related research. Not only do crucial concerns remain in the areas of geo-hydrology, but new and alarming problems are evident. These issues reveal even more clearly the grounds for disqualification of the Hanford site from further consideration.

The following are WashPIRG's major concerns:

1) The USDOE utilized overly optimistic assumptions about hydraulic gradients, permiability, porosity and thickness of the basalts at Hanford. These are key factors in determining travel time for radionuclides to reach the Columbia River.
2) The USDOE systematically failed to use standard conservative principles in making crucial estimates. They repeatedly used averages rather than values reflective of "worst case" scenarios.
3) The USDOE has not corrected past errors identified by the United States Geologic Survey (USGS) and the Nuclear Regulatory Commission (NRC).
4) The USDOE chose to ignore the possibility of vertical movement of water towards the surface. This is indefensible in light of the effect that heat from the repository could have on water movement and the likely existence of cracks and fissures.
5) The USDOE understated the dangers of rock bursts (explosions of rock walls caused by stress) to workers and the integrity of the repository.
6) The USDOE understated the possibilities of catastrophic flooding for the repository caused by accidental puncture of aquifers.
7) The USDOE relied too heavily on technical fixes to the problems posed by the concentrations of methane gas found at the site.
8) The USDOE ignored the implications of the 1936 earthquake near Milton-Freewater which the NRC attributed to a fault nine miles from the site.

Based on our review of the Draft Environmental Assessment for Hanford, WashPIRG calls for disqualification.

INTRODUCTION

The Nuclear Waste Policy Act of 1982 (NWPA) established the timeline and process by which a permanent underground repository would be estabished for the isolation of high-level nuclear wastes. The Department of Energy (USDOE) is responsible for the process of site selection, operation and closure.

In February of 1983, the USDOE identified nine potential sites in 6 states. Although original timelines became impossible to follow, Draft Environmental Assessments (EAs) were produced on time for each of the sites, estabishing the suitability of nine designated sites by comparing data from scientific investigations to specific siting guidelines. The siting guidelines describe qualifying and disqualifying characteristics of the site and describe criteria for ranking sites according to their overall suitability.

The Hanford draft EA expresses the opinion that Hanford and two other sites showed "the most advantageous combinations of characteristics...for the successful development of a repository...". The three top ranked sites will be studied further in a process called site characterization.

A complete, definitive EA would include full knowledge of the existing site characteristics, the full effects of physically locating a site there (pre-closure guidelines) and the post-closure effects of the repository. Many problems are revealed in the EA which render the Hanford site questionable, rather than justify its approval as a candidate: 1. "inadequate data" demands further study before final conclusions; 2: the consideration of data gathered predominantly by USDOE or the USDOE's contractor (Rockwell International) could be an optimistically biased basis for EA analysis. Rockwell's data has been challenged in the past by the USGS, state hired consultants, and individual scientists; 3: assumptions were made as the basis for isolation capability projections and could differ drastically with conclusions from other estimates. 4: the siting guidelines themselves are a subject of debate and many challenges. Some have complained that they are not stringent enough to protect the public and the environment.

The Department of Energy has already held a public briefing on the EA and is required to hold hearings for public comment. These fact sheets are designed as guides to the EA and can be used as tools in formulating testimony and educating the public. The comment period on the EA lasts until March 20, 1985, when written statements must be submitted. This marks the LAST opportunity for comment on the site selection process and the nomination or rejection of Hanford as a candidate site. After nomination by the USDOE, the president chooses the final site. The state then has veto power, but Congress can override the veto.

Hearings are scheduled on: <u>March 5, 1985 in Richland</u>
Federal Bldg. Auditorium
825 Jadwin
<u>March 7, 1985 in Olympia</u>
Dept of Soc. and Health Serv.
Hearing Room, Office Bldg. 2
12th & Franklin, Olympia
Times: 2:00 - 5:00 pm &
7:00 - 10:00 pm
for both meetings

for more information:
contact WashPIRG
State Office

GEOHYDROLOGY

Geohydrology is a crucial factor in assessing the suitability of the Hanford Basalts for a waste repository. The stored radionuclides would be carried into the environment via ground water flowing through the basalts. The chapter in the Environmental Assessment (E.A.) on geohydrology attempts to estimate the length of time it takes for ground water to flow from the repository to the accessible environment.

Millions of years ago Eastern Washington was repeatedly covered by massive lava flows erupting from fissures in the ground. Today, if you could view the Hanford site in cross-section, you would see these flows (now cooled to form basalt rock) lying one atop the other for thousands of feet underground. The tops of each flow consist of fractured rock above denser interiors. Some flows have "interbeds" or layers of highly porous sedimentary deposits between them. In addition to these features, irregular faults and fractures caused by cooling exist within the basalt. The flow tops and interbeds are known to contain moving ground water.

The E.A., in estimating the time it will take for ground water to reach the "accessible environment", chose as a starting point a flow top directly above the repository. The time for water to travel ten kilometers within the rock was estimated. (The Columbia River happens to be 10 kilometers, or 6.2 miles, from the site.) Since there is no data on vertical water movement, the travel time from the flow interior to the flow top was not included. Therefore travel time estimates are conservative.

Travel times of groundwater through rock depend on:

1. Transmissivity (rock permeability)
2. Effective thickness (rock porosity)
3. Hydraulic gradient (differential in water pressure)

Tests to determine these parameters have been conducted with boreholes drilled in the basalt since 1976. Nevertheless, data remains sketchy. The E.A. admits, "investigators used substantial interpolation and judgement" to prepare their models for groundwater movement.

Three models were generated from this data, using different statistical techniques. The results were median travel times of 17,000, 81,000, and 86,000 years. The 81,000-year model was deemed the most reliable because the USDOE felt the data reflected the uncertainties present, and included the widest probable range of results.

The E.A. stresses that these are preliminary results, and that a final determination on geohydrology must await characterization. The figures merely intended to show that the guidelines (site disqualified if travel time is less than 1,000 years, favorable if greater than 10,000 years) are likely to be met.

DISCUSSION

Much criticism needs to be leveled at USDOE's use of data. Specifically, many data sets and assumptions are overly optimistic.

Several specific problems with the USDOE's determination of geohydraulic travel times are evident:

1. There is little available permeability data from the individual horizons (flow layers where the repository would be built). Therefore, USDOE <u>assumed</u> that each flow top would have the same permeability as the Hanford area basalts as a whole.

2. Only one data point within a single flow has been measured for effective thickness. USDOE <u>assumed</u> that this was a representative value for all the flows.

3. The USDOE rejected their 17,000-year estimate because the porosity value used in the calculation was roughly ten times greater than most values observed. Yet the fact is that greater values were observed in experiments at the proposed site. The 17,000-year result thus appeared to be based on a more conservative, and therefore more prudent, estimate. But this model was ignored and not used to assess Hanford's suitability.

4. Several measurements have been made of the hydraulic gradient, but the values are low, and difficult to determine, introducing uncertainty into the models.

WashPIRG feels that averaging of data must lead to error. Waste will reach the environment by the path of least resistance -- the fastest path. Conservative estimates should rely on the highest values observed in a given observation, not an average.

Most troubling of all was the omission of a variety of other key independent studies which used the same raw data yet showed travel times to the Columbia well below the 1000 year minimum.

Significantly shorter travel time calculations have been produced by the U.S. Geologic Survey (USGS), the Nuclear Regulatory Commission (NRC), State of Washington consultants, and independent scientists. The NRC estimated the time as low as twenty years, and accused USDOE of relying heavily on favorable data and assumptions, while avoiding unfavorable data by saying more testing is needed.

Much of the criticism from these non-USDOE analysts centers on USDOE's analysis of borehole data to describe the geohydrology system at Hanford. The E.A. is heavily based on the concept that most water moves horizontally along flow tops and interbeds, with minimal vertical movement through basalt interiors. It recognizes the possibility of faults and structural discontinuities increasing vertical movement, but states that little evidence of these effects have been found. The E.A. decides to ignore vertical movement for the time being and not to make a determination until further testing takes place.

In addition, the USDOE used data indicating there were chemical differences in groundwater within the various layers of basalt to support the idea of minimal vertical mixing. Yet unused data from other boreholes seem to indicate the opposite -- that significant vertical mixing of groundwaters is likely. Both USGS and Hanford Oversight Committee (HOC) stress that groundwater flow in the Pasco Basin is 3-dimensional, moving upwards near major streams like the Columbia River. (The USGS calls the whole system "leaky".) More vertical mixing increases the possibility of waste following a path to the environment faster than the horizontal paths studied by the USDOE.

The basalts below Hanford are complex and heterogeneous. There are many unknowns. Many analysts have stated that this complexity may preclude reliable estimates on many critical parameters. Indeed, federal guidelines call for disqualification of a site if characteristics such as those affecting travel time are "too complex to allow reasonable confidence...".

Perhaps the strongest objection concerning geohydrology is the presence of the Columbia River, just 6 miles away. As Physicist Brian Baird has stated: "Closeness to the river becomes very important if the USDOE analysis of groundwater travel time is not reliable."

In light of this substantial body of criticism, it appears the E.A. relies on optimistic assumptions in trying to predict groundwater travel time, avoiding many uncertainties by saying they will be better understood after further tests during characterization. In WashPIRG's view there exists enough evidence to disqualify Hanford on geohydrological grounds.

ROCK CHARACTERISTICS AND MINING

The repository would be constructed 3,000 to 4,000 feet underground, one mile wide and two miles long. The working tunnels will be ten feet high and twenty feet wide to accomodate the workers and machines needed for excavation, construction, nuclear waste movement and emplacement. The waste will be placed in 200 foot holes bored in the walls of the main tunnels.

The excavation will be a tremendous operation requiring the cutting, fracturing, and removal of millions of tons of rock. Access shafts and tunnels will be drilled through several water-bearing layers of rock. Large amounts of water will have to be pumped out.

The evidence used to compile the sections of the E.A. on rock construction was obtained from on-site narrow and deep boreholes, on-site shallow excavations, international mining data and testing of Hanford's sample basalts in laboratories.

DISCUSSION

A number of severe potential problems call into question the suitability of the Hanford site. These include 1) rock stress, 2) unacceptable construction hazards, 3)problems related to aquifer pressure and flooding, and 4) shaft instability leading to collapse.

Of particular concern is the highly imbalanced horizontal to vertical stress found in the basalt. Many scientists have noted that the horizontal:vertical stress ratio of 2:1 (USDOE's final estimate) or 2.7:1 (other test estimates) creates dangers in mining the shaft. A stress-caused phenomenon called "disking," in which poker chip-like pieces of rock flake off and plug up the shaft, is expected to occur. Horizontal stresses and extraordinary high stress areas could create localized rock bursts (in effect, small explosions), and cave-ins, presenting an extreme danger to workers during construction and repository operation. Such rock bursts could also cause major shaft and repository damage.

Similarly, an accidentally punctured artesian aquifer could release water under high pressure (about 1,400 lbs/sq in) and burst the shafts, making the repository obsolete and the waste unretrievable. Probing for these problem areas with exploratory boreholes should help prevent major difficulties -- but the consequences of mistakes could be disasterous.

Other important areas of concern include:

** A 50 percent methane gas saturation of groundwater, which will require extensive hydraulic pumping. Methane gas is toxic and combustible, and would pose a health hazard to repository workers;

** Underground rock temperatures at the site of 124°F, which will require refrigeration to 81°F for bearable work conditions;

** Test boreholes penetrating various levels of rock and aquifers which will provide additional radionuclide escape routes;

** Problems with grout-sealing of the shaft once it is filled. There is no guarantee that the seal will remain preserved for the necessary 10,000 years.

** NO shaft with the diameter of that planned at Hanford has ever been bored through basalts to the depth required.

** NO on-site tests have been undertaken to determine the effects of high waste temperatures on the rock. Thermally induced stress increases the chances of rock bursts and new fractures. The actual effects of the magnitude of the shaft and the heat of the wastes are unknown and warrant grave concern.

WashPIRG questions why only the studies showing favorable results were included in decision-making, while unfavorable data went

unheeded. In a newly-published report from the Health & Energy Institute on the Hanford site selection, Donald E. White, formerly of the U.S. Geological Survey, writes,

> the individual problems such as rock-bursting, high temperatures, and hot ground-water may each be individually tractable; but all in combination may be inoperable in cost of money, time, energy, and loss of lives...

The USDOE admits the uncertainties of the studies it used to justify Hanford's nomination for further study in regard to mining and rock characteristics. However, WashPIRG takes the position that it is this very lack of certainty that should disqualify the site. The public interest was ill-served when the USDOE determined Hanford was qualified.

If Hanford does indeed undergo intense characterization despite these problems, we believe that the feasibilty of safe construction is a prerequisite for further research, especially since the site characterization process will include the drilling of a 9 foot diameter exploratory shaft. Detailed study must be done at the earliest possible date to assure a safe process of construction, operation and closure.

TECTONICS

Faults, plate movement and earthquakes are the most important elements of tectonic studies pertaining to the Hanford site assessment. The conditions specified by the USDOE regarding tectonics state:

> The site shall be located in a geological setting where future tectonic processes or events will not be likely to lead to radionuclide releases greater than those allowable under the legal requirements.

The Environmental Protection Agency has set this release requirement at the amount of radiation that will kill no more than 1000 people over a 10,000 year period.

DISCUSSION

The Hanford site may fail to comply with the standard of the E.A. Within the Columbia Plateau and the Pasco Basin, where the Hanford site lies, are vast and complicated geological structures. The most threatening of these structures are faults -- along which earthquakes originate. The evidence of faulting at the site was not mentioned in the E.A. In fact, the USDOE even directly denies the existence of faulting under the site. But evidence exists of faults and past earthquakes that may work to promote groundwater movement and shorten the travel time for radionuclides to reach the accessible environment.

Perhaps the most controversial geological structure within the area is the Rattlesnake-Wallua fault zone (RAW). RAW is a 120 kilometer (75 mi.) fault zone that originates near the Blue Mountains and travels northwestward to Rattlesnake Mountain. The RAW passes within 9 miles of the site.

In 1936 an earthquake near Milton-Freewater, Washington registered 6.5 on the Richter Scale. The USDOE attributes the 1936 earthquake to another fault, the Hite fault, which runs along the face of the Blue Mountainns and then travels into Idaho. The NRC, however, stated in 1983, "[the Milton-Freewater earthquake] must be attributed to movement on the RAW." If this is the case, then the earthquake hazard at the site is considerably higher than the E.A. suggests.

Other hazardous faults exist within and near the site. For example, the Yakima anticlines (up-arched folds of earth) lies south of the site, and runs directly westward. The most recent structural interpretation of this formation is that it may project to or under the site. If this is correct, microearthquakes will occur within or around the site. In 1982 geologists from the University of Washington reported microearthquakes in the vicinity of the Hanford site. The NRC recognized these earthquakes as "evidence of fractures and faulting." These micro-earthquakes could cause rock bursts or opening fractures when high stress rock formations are affected. The result could damage the waste containers or make waste retrieval impossible, (see "Rock Characteristics"), as well as work to expose radioactivity to the environment much sooner than estimated.

Other evidence of faults and fractures were discovered by geologist, F. E. Goff, who worked for Rockwell International (the company contracted by the USDOE to carry out the assessment). He found that faults from the Umtanum reverse fault (which is directly east of the proposed site) extend westward and downward into the site itself.

The evidence of faulting at the proposed site is not dealt with adequately in the EA. WashPIRG objects to the USDOE determination of the Hanford site as suitable based on insufficient data, especially regarding the existence of faulting at the site.

TRANSPORTATION

The environmental assessment of the Hanford site includes only a general review of factors related to transportation, and describes the present national transportation system. The assessment does not include a site specific evaluation of routes, plans for the design and safety standards of waste transport containers, specific investigation of the hazards related to accidents, or information on the limitations of the existing transportation system.

Specifically, the E.A. attempts to determine whether any localized adverse conditions will result if a repository is sited at Hanford. Federal guidelines, while not identifying any disqualifying conditions, require that the site not conflict with nationally-protected resources, require unreasonable construction technology, or pose any unacceptable risks to the public or environment. In addition, transportation operations connected with the repository must not require regulations more stringent than current Federal policy regarding nuclear waste transport, or development of new packaging technology.

The USDOE admits that it doesn't have enough data to reach a final conclusion regarding the acceptability of the Hanford site with regard to its transportation requirements. Many key aspects of the transportation system are still unknown: the shipping casks that will be used to transport the waste have not yet been developed; the characteristics of the final transportation system cannot yet be forecast; information about specific routes and carriers cannot be forecast either.

DISCUSSION

WashPIRG's believes that the chief short-coming of the transportation section is its limited, regional discussion of the transportation system. The only true basis for comparison among the proposed sites is an evaluation of total accidents expected on the routes associated with each site, and a similar site-specific evaluation of the transportation problems that will result as dozens of trucks and escort vehicles make their way across the country every day in all weather conditions. Back-ups and delays resulting from bad weather and rerouting in response to accidents and weather hazards have not yet been discussed. Computer models exist, most notably at the Oak Ridge National Laboratory in Tennessee, which were expressly designed to do such calculations.

It is important to remember that the waste arriving at a Hanford repository will have traveled thousands of miles from reactors in the east. Although USDOE expects 17 shipments per day there is no discussion of local or national emergency response plans. In fact USDOE suggests that State and local authorities have primary responsibility for emergency response, although USDOE will provide technical advise upon request.

WashPIRG is very disturbed by USDOE's definition of radiological hazards associated with transportation of radioactive waste as being those "which would result from the direct external radiation emitted by the radioactive waste as a shipment passes by...", and the companion definition of transportation accidents as "nonradiological risks". Transportation accidents, both rail and truck, can, and have in the past, resulted in spillage of radioactive material.

SOCIOECONOMICS

The Department of Energy (USDOE) contends that siting the nation's first commercial nuclear waste repository at Hanford will not have significant socioeconomic impacts on the surrounding communities. Impacts are defined as surpluses and shortages of public and private goods and services. They are determined by the magnitude of change that siting a repository would cause, and the community's ability to deal with the changes.

The Hanford site is unusual compared with other nuclear facility sites in the U.S. in that there is a major metropolitan area located relatively close by (approximately 20 miles) and a large number of smaller unincorporated cities further from the site. The region in question is defined as the Tri-Cities, West Richland, Benton City and surrounding areas, and is referred to on a larger scale as Benton and Franklin counties.

The economy in these counties is driven primarily by agriculture, the USDOE and the Washington Public Power Supply System (WPPSS). During the 1970s this region was characterized as one of the most rapidly growing metropolitan areas in the nation. This was due mainly to large scale construction projects for WPPSS. Since construction on these projects was halted in 1981, the region has been experiencing an economic decline. Jobs have been scarce and people have been forced to leave the area, creating a surplus of social services, housing and other goods. It is this pattern that allows the USDOE to characterize the study region as having a high "absorptive capacity" (the ability to deal with the magnitude of social changes that siting a waste repository would bring).

The repository has a long time line including: study of the site to assess its suitability, construction of the repository, operation of the repository, monitoring and retrieval of wastes, and backfilling. The greatest number of workers will be needed in the first twenty years. Current estimates place the work force size requirements at approximately 1100 during construction, 800-900 in operational phase, and declining to 112 during the caretaker phase. It is important to note that the overall work force size requirement is relatively small in comparison to past development activities in the area.

DISCUSSION

With increasing employment opportunities it is likely that skilled workers from outside the region will be willing to relocate, thus reducing the number of jobs that might have been available to local residents and commuters from surrounding areas. Also, the prospect of employment may attract more workers to the area than can be employed, causing a migration of unsuccessful job seekers.

The impacts of the proposed repository on agriculture in the region are difficult to predict. Contamination of the soil or irrigation water would, of course, destroy the industry. Assuming, however, that adequate precautions are taken, fear of contamination on the part of target agricultural markets could reduce the demand for food products from the region, and seriously cripple the industry. The likelihood of this possibility is uncertain, but once it occurs it could be expected to be fairly permanent, due to the long-term nature of radioactive contamination.

Construction of the proposed waste repository will increase the demand for resources and materials in the area, such as gas,

electricity, oil, concrete and gravel. The USDOE insists that local firms which were able to provide for past construction projects could supply the materials and services required. With a projected cost of over $100 million, this could have a positive impact on the local economy. However, with no guarantee that local vendors will be used, project dollars spent outside the area will decrease the potential for economic advantage.

Although the area currently has a great "absorptive capacity," large development projects can strain community security by imposing demands on those services at a faster rate than the community can deliver. It is estimated that excess housing and public service capacity in the region would disappear in the 1990s and that further growth would require expansion of those services in order to avoid negative impacts. Long time residents may find their property taxes rising, or the makeup of their neighborhoods changing rapidly. Also, the waste repository could have a negative effect on property values.

The problem with assessing socioeconomic effects is in identifying what changes would be brought about by the proposed repository as opposed to other factors. It is impossible to predict what other aspects of the region's economy would be affected by the siting of a waste repository. WashPIRG poses the following questions:

- Could siting a repository actually stifle the area's economic diversification?
- Is the USDOE placing too much confidence in the repository as an economic booster to the community?
- Are USDOE predictions purposefully optimistic?