Section I.I. General Accounting Office Report

The DOE's mismanagement of its INL nuclear operations has a very long history. Investigations finding violations are so common and frequent, yet no fundamental changes in sue because there is no accountability that deals with the underlying causes. DOE contractors responsible just consider fines as a "cost-of-doing-business" that are factored into the contract fees and passed on to the taxpayer. This scenario will keep repeating until criminal charges are included on responsible management for violating laws that impact worker and the public health and safety.

The INTEC formerly Idaho Chemical Processing Plant (ICPP) was temporally shut down in 1989 for Resource Conservation Recovery Act (RCRA) violations. Despite the loss of its mission of extracting highly enriched uranium from spent reactor fuel, DOE plans to rebuild the ICPP to current standards so that it can maintain its nuclear materials production capacity. See Section II(A). Responding to public concerns, Senator John Glenn (D-OH) requested that the Congressional General Accounting Office (GAO) conduct a study on INL.

Environmental Problems at DOE's Idaho National Engineering Laboratory (GAO-RCED-91-56) was released April 15, 1991. "The Energy Department faces immense cleanup and environmental compliance problems at INL," stated Glenn. "Although DOE and its contractors recognize the scope of this problem, their continued failure to meet compliance deadlines could harm the health and environment of our citizens as well as our national security." [Glenn(a), 4/15/91]

According to the GAO report: "there are releases of radioactive and hazardous contaminates into the soil, groundwater and drinking water at INL. Tons of hazardous substances, such as chromium, were directly injected into the Snake River Plain Aquifer - an important fresh-water source for the region. [Ibid.]

"The Idaho Chemical Procession Plant [ICPP], which manages spent nuclear navy reactor fuel, has been shut down since July of 1989 due to costly replacement of 6,000 feet of radioactive waste pipes and 11 large-scale underground waste tanks. The shut-down was triggered after INL officials discovered that an underground pipe had corroded through -- leaking unknown quantities of high-level radioactive waste to the environment. According to GAO, the pipe failed because it was `incompatible with corrosive waste it carried' and lacked a secondary containment as required by federal environmental law." [Glenn (a)]

"Currently, DOE has identified over 200 inactive waste sites at INL, which, according to the GAO, `could be a continuing source of contamination to the Snake River Plain Aquifer.' Large quantities of plutonium wastes were dumped at INL that have migrated as far as 110 feet toward groundwater. Four injection wells disposed large quantities of trichloroethylene that have contaminated drinking water wells above federal and state limits." [Glenn (a)]

"Another major [Resource Conservation Recovery Act] RCRA-related containment problem involves waste storage tanks. Of most concern are eleven 300,000 gallon underground waste storage tanks at the chemical processing plant's tank farm. These stainless steel tanks are used to store the highly radioactive acidic wastes resulting from the nuclear fuel reprocessing operation before the wastes are calcined into a solidified granular form. The tanks were cited for incompatible secondary containment because of a June 1989 EPA inspection at the plant. The tanks have a form of secondary containment because they are encased in individual concrete vaults designed to contain leaks. Yet, EPA determined that the vaults do not meet secondary containment standards because of material incompatibility with liquids stored in the tanks." "...five of them

[tanks] are considered especially vulnerable. This is because their containment vaults consist of several concrete panels, grouted at the seams that are more likely to leak or breach in a major earthquake than the six other tanks."

"At both the Chemical Processing Plant and the Radioactive Waste Management Complex, as well as at other INL locations, DOE has identified problems associated with storing its mixed wastes. The problems involve, among other matters, the storage of (1) mixed wastes without having EPA-approved treatment technologies available, (2) stored nuclear fuels that may qualify as mixed wastes subject to RCRA requirements, and (3) mixed transuranic wastes in configurations that do not meet RCRA storage requirements. According to several DOE officials, these issues could ultimately result in RCRA related lawsuits and/or shutdowns of other INL facilities if they are not resolved." [GAO (b) @ 5-6]

"A second RCRA-related storage issue at INL involves nuclear fuels that may contain hazardous constituents. Under RCRA, DOE was required to seek permits to continue various operation involving the handling, treatment, storage, and disposal of hazardous wastes. DOE did not include the nuclear fuel storage operation at INL in its permit applications because it did not identify the fuels as mixed wastes subject to RCRA -- these fuels are classifiable as special nuclear materials under the Atomic Energy Act. In this regard, DOE did not originally consider any of the materials in the fuels to be subject to RCRA, even though some of the fuels stored at INL contain hazardous constituents such as cadmium, silver, metallic sodium, or metal carbides." [GAO(b) @ 6-7]

"DOE has not estimated the total costs that would be involved in cleaning up all of INL's inactive waste sites, but partial estimates indicate the cost will be substantial." [GAO @ 9]
"Included in the [GAO] report are 113 environmental findings related to air and water protection, waste management activities, cleanup of inactive hazardous waste sites, protection against toxic and chemical materials, National Environmental Policy issues, quality assurance, and other issues ... including an additional 317 safety and health findings." [GAO (b)@ 19]

Then Idaho Governor Andrus stated that, "Nationally, the DOE's waste management practices remind me of a credit card consumer who is nearing the $1000 limit on his charge card. DOE has charged $999, but now wants to make another purchase. Unfortunately, we have reached the limit on waste and it's time to pay the bill. We must, as a nation, come to grips with the problem, address it honestly and solve it. Unless and until the waste dilemma is solved all new projects are in jeopardy and DOE will encounter increasing reluctance on the part of the public and public officials to support open ended assurances that waste management is really being addressed."[Andrus(b)]

Idaho Health and Welfare has identified 27 violations of State environmental laws at INL. Although unenforceable, the fines would add up to $115,000. Violations included air, water, hazardous materials handling, waste tanks, waste percolation ponds and trenches. [IDH&W Notice 6/5/91] In a more recent notice of violation (3/21/96), the State Division of Environmental Quality levied enforceable fines on INL totaling $317,300 for 61 violations of the Hazardous Waste Management Act.

Battelle Energy Alliance was fined $412,500 for violations of quality assurance requirements and occupational radiation protection by the Department of Energy. The fine, which stemmed from two 2011 incidents involving worker radiation exposure, was announced Thursday. It was included in a letter from John S. Boulden III, director of the DOE's Office of Enforcement and Oversight, to lab Director John Grossenbacher.

Alex Stuckey reports 11/7/12 in the Idaho Falls Post Register: "Start-up delays at the

sodium-bearing waste treatment facility on the Department of Energy's desert site have caused the DOE to miss two Site Treatment Plan milestones. The DOE also will miss a milestone on the 1995 Idaho Settlement Agreement because of these delays. "We've had technical issues (with the treatment of this waste)," DOE spokesman Brad Bugger said. "We will eventually complete these milestones."

The Site Treatment Plan was established by the Federal Facility Compliance Act, which requires federal facilities to develop a plan outlining how to handle the generation, storage, treatment and disposal of mixed waste. The DOE is required to submit this plan to the Idaho Department of Environmental Quality every year. Because the DOE missed the milestones, the Department of Environmental Quality could fine the DOE up to $10,000 per day per violation until the milestones are met, Department of Environmental Quality spokesman Brian Monson said.

The delays came in June when nonradioactive material clogged a filter at the Integrated Waste Treatment Unit, which would process the sodium-bearing waste. Sodium-bearing waste contains a low level of radiation, the leftovers from reprocessing high-level radiation spent nuclear fuel. The settlement agreement required the removal of 900,000 gallons of sodium-bearing waste by Dec. 31. The waste is located in tanks at Idaho National Laboratory's Idaho Nuclear Technology and Engineering Center.

One missed milestone is for the date when sodium-bearing waste treatment at the Integrated Waste Treatment Unit must begin. The other is the date when the DOE must submit a schedule identifying the time required for processing the waste in storage. The DOE has asked for an extension on both milestones into 2013. The department will not be subject to a fine until the final determination is made.

Alex Stuckey reports in the Idaho Falls Post Register: “Battelle Energy Alliance was fined $412,500 for violations of quality assurance requirements and occupational radiation protection by the Department of Energy.

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“The letter said the exposure incidents were of "high safety significance." Grossenbacher is president of Battelle Energy Alliance, the contractor that runs the INL facilities on the DOE site west of Idaho Falls. "We agree with the findings and we will pay the fine," Grossenbacher said.

“In an email, INL spokesman Ethan Huffman said the fine will be paid from Battelle corporate funds, not taxpayer dollars. "Our system failed and we came very close to hurting some people," Grossenbacher said. "We were lucky, but we don't operate this place on luck."

“The DOE's preliminary notice of violation cited violations committed by Battelle, including failure to identify processes needing improvement, failure to effectively train personnel to perform their assigned work and failure to perform real-time monitoring.

“The incidents for which Battelle was fined happened: On Aug. 30, 2011, when an operator received an elevated radiation dose to his right hand while processing fuel samples at the Materials and Fuels Complex's Hot Fuel Examination Facility.

“On Nov. 8, 2011, when 16 workers were exposed to plutonium radiation at the building that once housed the Zero Power Physics Reactor at the MFC. At least one worker inhaled the radioactive substance.

“The DOE letter said both incidents involved deficient work control documents and failure to perform work consistent with approved procedures. "Clearly the (November) event was

unfortunate and doesn't meet our standards," said Phil Breidenbach, the MFC's mission support director.

"In order to comply with the DOE's recommendations, the MFC has a list of nearly 80 corrective actions it must enact to improve work planning, procedures and training. About 75 percent of the corrective actions already have been put in place, Breidenbach said.

"The DOE has not made public the list of corrective actions. INL officials said none of the 16 workers exposed in the November incident would experience adverse health problems as a result of the radiation exposure. They said the workers exposed to plutonium-239 in November had received radiation that was within the DOE's annual regulatory limit.

"According to the U.S. Environmental Protection Agency website, "internal exposure to plutonium is an extremely serious health hazard. It generally stays in the body for decades, exposing organs and tissues to radiation, and increasing the risk of cancer. "Plutonium is also a toxic metal and may cause damage to the kidneys."

"INL officials, citing the Health Insurance Portability and Accountability Act of 1996, would not release each worker's individual dosage rate. In discussing the November incident, INL officials said that over the past 11 months, more than 1,400 analyses were performed on 228 different biological samples. A solubility study also was performed to determine the rate at which the inhaled radiological material is dissolving and exiting the body.

Section I. 1. Tiger Team Report on INL

To show how poorly DOE managed INL, former DOE Secretary Watkins established a special investigative "Tiger Team" comprised of environmental, health and safety experts to evaluate the DOE sites. The Tiger Team investigated INL in July 1991 and characterized the site as an extremely complex entity with a diverse multi-program mission. This diversity of organizations/contractors and the fact that programs at the INL are sponsored by several offices at DOE Headquarters, has contributed substantially to the overall complexity of the Tiger Team assessment. The following deficiencies were cited in 1991:

1. "The programs required to achieve full compliance with current Environmental, Safety, and Health (ES&H) requirements and to ensure progress towards excellence have not been developed and implemented at the INL.
2. Of particular concern is the lack of oversight of construction, EG&G Idaho's semi-autonomous departments and a particularly deficient radiation protection program, and a pervasive lack of attention to detail at the Chem Plant.
3. No environmental expertise was on staff within the Argonne Area at INL and that several deficiencies that related to the validity of data produced or used by the Radiological and Environmental Sciences Lab for the calculation of dose to members of the public from radiological releases.
4. There is doubt about the ability to accurately measure emissions and calculate dose as a result of unplanned releases.
5. Staff and management training and experience in the recognition of OSHA hazards are severely lacking at the INL.
6. INL has a lack of a comprehensive, cohesive management approach, and virtually no independent ES&H oversight program.
7. INL operations office lacks an arms-length relationship with the contractors resulting in

ineffective management of the process of awarding of fees which are several areas fundamental to successful operations at the INL but for which the performance level is deficient.

8. Both the large number and the significance of the non-compliance found throughout INL and its contractors are particularly troubling considering that the overall Tiger Team initiative has been underway for more than two years." [Tiger Team]

Section I.2. Inspector General's Audit of INL

DOE's Inspector General conducted an audit of INL's construction projects in October 1995 which revealed that $26.4 million in construction projects were unneeded. The audit report states that, "[INL] continued to pursue and budget for these projects because it did not (1) consistently verify the need for these projects; (2) independently identify and evaluate alternatives; (3) reassess the need for these projects in light of the Laboratory's current and foreseeable mission requirements." [WR-B-96-03 @ 5]

The auditors randomly selected 52 projects out of a total of 290 projects at the INL. Seven of those 52 randomly selected projects were found not to be needed due to downsizing at the site. The 52 projects represent a high (18%) random sample rate that is statistically more reliable than a lower sample rate. Those seven projects represent a 13% problem rate that is statistically significant. The auditors do not acknowledge this important fact and recommend a more extensive review be conducted on the other 238 projects. Is there an unstated basis for not recommending a complete construction audit?

The report specifically cites DOE/ID and Lockheed Martin reassessment deficiencies as the cause of $26.4 million in unneeded construction spending. If DOE/ID is not conducting adequate independent verification of need in the construction projects, it stands to reason that problems in other areas of operations may also exist. The report fails to recommend any additional audits in other operational areas.

The auditors recommended canceling the $1.3 million parking lot upgrade project at the Naval Reactors Facility because it was not needed. Why is funding for these Defense Programs coming out of DOE's Environmental Management (EM) budget in the first place, is the real question that needs to be asked. Also see Section III(A).

While it is indeed heartening to see the Department continuing to exercise management control over its field operations, one need only review the August 1991 Tiger Team Assessment of INL to see that little has changed. Clearly, the Department needs to develop a new and effective management process, otherwise the old culture will continue to thumb their noses at headquarters. To his credit, former DOE Secretary Admiral Watkins understood that the field offices were out of control and initiated a more centralized management structure. Secretary O'Leary appears not to understand the mistakes of the past and is attempting to decentralize again (back to the DOE Secretary Harrington era) before the old culture is changed. This is a fundamental mistake in our view.

The audit also found that the Department's Project Management System (Order 4700.1) was violated when a $3.3 million construction project was split into three separate projects in an attempt to circumvent line item budget requirements. Field offices "...are responsible for ensuring the proper classification of all construction projects. Specifically, this Order requires the Department's field elements to classify all projects exceeding $2.0 million as line item construction projects, and to obtain approval from Congress before initiating these types of

projects." [WR-B-96-03 @ 13]

The audit found, however that a Westinghouse Idaho Nuclear Company official split into three other projects a $3.3 million voice paging and evacuation system upgrade project "...because he believed the Department would not approve the entire project as a single line item." ... "The Office of Inspector General believes that Idaho's internal controls are weak in detecting and preventing future instances of project splitting. Accordingly, the Idaho Operations Office should also consider this condition when preparing its year end assurance memorandum on internal controls." [WR-B-96-03 @ 13, 14]

Despite the Inspector General's audit, DOE headquarters awarded Lockheed Martin a bonus of $14.15 million on top of operating costs for a job well done in 1995. [AP(d), 1/4/96] The Government Owned Contractor Operated (GOCO) system DOE uses together with cost plus contracting is fertile ground for abuse. Fines imposed on contractors are simply factored in as a cost of business that also offers the government fig leaf cover to any challenge to its inadequate oversight.

Section I. J. Earthquake & Volcanic Hazard

A major hazard that INL faces is "Climate Disaster" that looms within the next decade over nuclear operations. The time imperative of one-two decades of sea/river rise and storms/hurricanes/tornados that are a product of "Climate Disaster" must be included in the calculous of "natural" disaster. DOE's delays in completing nuclear waste cleanup will be severely impacted because regular life on the planet will become nearly impossible.

As the Associated Press said: "As reactors melt down and release radiation in the wake of a 9.0 earthquake in Japan, it's natural to wonder about the safety of the nuclear facility near Idaho Falls, 100 miles upwind of Jackson Hole.

"The Idaho National Laboratory sits in the middle of a seismically active area where more than 9,300 quakes occurred between 1972 and 2007, according to its website. The largest of those quakes was the 7.3-magnitude Borah Peak temblor in 1983, which killed two children in Challis, caused an estimated $12.5 million in damage and lifted the state's highest peak by 7 feet.

"Although there are fault lines in the surrounding ranges, the nuclear lab is located in the Snake River plain, where only minor quakes — less than 2.0 in magnitude — have been recorded since the monitoring system was installed, according to the facility's website."

The AP reported in 2008"Scientists watch unusual Yellowstone quake swarm [just east of INL]: Scientists are closely monitoring more than 250 small earthquakes that have occurred in Yellowstone National Park since Friday. Swarms of small earthquakes happen frequently in Yellowstone. But Robert Smith, a professor of geophysics at the University of Utah, says it's very unusual to have so many over several days. The largest tremor was Saturday and measured magnitude 3.8. Smith says it's hard to say what might be causing the tremors but notes that Yellowstone is very geologically active. An active volcano there last erupted 70,000 years ago." [Scientists watch unusual Yellowstone quake swarm, Associated Press CHEYENNE, WY December 29, 2008]

DOE continues to understate the geologic risks at the INL. The Arco and Howe seismic faults shown in the 1991 New Production Reactor Draft Environmental Impact Statement (DEIS) maps are not consistent between maps. (DEIS(a)Vol. 2, 4-59 and 4-60) The faults shown seem to mysteriously disappear under the INL site and then reappear on the other side of the site. Moreover, if the DEIS 4-59 and 4-60 seismic maps are superimposed on the 4-57 Volcanic Rift Zone map one can easily see that the faults match the rift zones.

A rift, as defined by the American Geologic Institute dictionary is: "a long, narrow continental trough that is bounded by normal faults; a graben of regional extent. It marks a zone along which the

entire thickness of the lithosphere has ruptured under extension." This dictionary also states that rift zones have associated volcanic activity. Therefore, a rift zone by definition contains faults, very deep seated ones that have the potential to erupt lava. [Schlak]

A 1977 EIS of INL found that, "Faults near Arco and Howe extend south and southeast toward the INL. The Arco Fault is 30 miles from ANL-W and the Howe Fault is 20 miles distant. Other INL studies postulate subsurface extensions of these faults to within six miles southeast of ANL-W." [ERDA-1552 @ I-56]

Idaho's former Governor Andrus criticized the Department of Energy's (DOE) seismic risk assessment process. "To provide the state of Idaho with a better understanding of the seismic risk assessment process, we have repeatedly requested technical observer status on the panels that are determining seismic hazard assessments. To date, the state has been denied access to the assessment process. We believe that impartial state representation would promote greater confidence in seismic findings." [Andrus(a)]

INL had an earthquake zone 3 rating prior to a 1982 that gerrymandering of the site reduced to a zone 2 (See Idaho Earth Quake Risk Figure). Zone 3 is the same seismic category as San Francisco. The strongest earthquake in United States recorded history, the Yellowstone quake, occurred in 1959. This quake had its epicenter only 137 miles from INL. The largest earthquake on the Centennial Tectonic Belt in Idaho (7.3) occurred in 1983 along the western flank of Borah Peak (Lost River Range) approximately 40 miles northwest of Arco. The largest earthquake within the Inter-mountain Seismic Belt (7.5) occurred in 1959 near Habgen Lake, 90 miles from the site. As a result, a new seismic zone of 4 was created adjacent to the INL site. In January through June 1994 a swarm of earthquakes hit Soda Springs, ID 60 miles south-east of the site - the largest reached 5.8 on the Richter Scale according to USGS. Among the 1994 quakes included the Draney Peak earthquake of 3 February 1994 (5.9) and Challis earthquake of 7 June 1994 (5.1) on the Richter scale.

A limited review of INL's 1979 to 1981 Quarterly Seismic Reports revealed that DOE contention in INL Environmental Impact Statement that the Snake River Plain is "aseismic" is unjustified. The following quakes were registered on or originated on the Snake River Plain: [RE-P-79 to 82 series]

Seismic Activity on Snake River Plain 1979-81

Year	Number of Quakes	Magnitude Richter Scale
1979 2nd Quarter	100	(5) greater than 3.0
1979 4th Quarter	68	0.1 to 1.1
1980 2nd Quarter	2	1.0
1980 4th Quarter	116	0.5 to 3.3
1981 1st Quarter	91	0.1 to 2.8
1981 4th Quarter	120	0.4 to 3.5

[RE-P-79 to 82 series]

Four rift zones and their related faults underlying INL from southwest to northeast

Rift Zone	Fault
Arco	Lost River Range
Howe East Butte	Lemhi Range
Lava Ridge/Hells Half Acre Circular Butte/Kettle Butte	Beaverhead Range

The 1988 Final Environmental Impact Statement for the Special Isotope Separator (SIS) did a seismic analysis of the INL site. "Based on the proximity to the INL and the likelihood of generating sizable earthquakes, the faults considered to be of most significance to the proposed SIS are the range front faults located along the western flanks of the Lost River, Lemhi, and Beaverhead Ranges." ... "It is apparent from extensive geologic investigations as well as historic evidence that the Lost River, Lemhi, and Beaverhead Faults are capable of producing large Magnitude 7 - 7.5 earthquakes in the future." [SIS@3-19]

"Detailed work on the Arco segment of the Lost River Fault indicates an average slip rate of 0.1 - 0.12 meters per 1000 years during the past 160,000 years. The fault has not ruptured in the past 30,000 years."... "If the slip rate has been constant, the fault has a potential strain accumulation of 3 meters (9.8 feet). Since characteristic earthquakes along the Lost River Fault produced less offset than this, it could be concluded that the Arco Segment is overdue and should have ruptured 10,000 - 20,000 years ago." [SIS@3-21]

"If an earthquake does occur, it seems most likely that it will be epi-centered approximately as far away from the INL as was the Borah Peak Earthquake, and that it will have approximately the same magnitude." ... "In the less likely event that an earthquake would occur on the Arco or Howe Segments during the lifetime of the SIS, ground motion would be stronger."... "Predicted peak ground accelerations were calculated assuming a 7.25 magnitude earthquake on either the Arco or Howe Segments approximately 30 kilometers (18 miles) from the proposed SIS site. Utilizing attenuation curves calculated for the INL by Tera Corp .... a peak horizontal ground acceleration of 0.22 g is predicted." [SIS@3-19] [ERDA-1552@I-57]

If DOE's geologists had applied an equivalent earthquake magnitude of the Borah Peak (7.3) to their calculations, the ground acceleration might well approach or exceed the structural strength of the ICPP high-level waste tanks of .24 g. (See Sec.I(E)(2) "Five of them [tanks] are considered especially vulnerable. This is because their containment vaults consist of several concrete panels, grouted at the seams that are more likely to leak or breach in a major earthquake than the six other tanks." [GAO (b) @4-5]

The State of Idaho commissioned a limited study by Boise State University seismologist James Zollweg, and University of Idaho seismologist Kenneth Sprenke, who found that "if a large earthquake struck, the biggest worry would be those tanks." Zallweg's assessment was endorsed by U.S. Geological Survey's Larry Mann who said, "that would be a catastrophic release. It could not be intercepted before reaching the aquifer." Zollweg calculated that, "if an earthquake of 7 on the Richter scale hit the fault closest to the tanks, a ground acceleration of about 0.24 g could hit the vaults". [Statesmen (b)]

A catastrophic risk exists with these forty-year-old tanks which DOE refuses to address. The tanks are 400 feet above the Snake River Plain Aquifer that provides drinking water for over 275,000 Idahoans. Scientists also believe that if the tanks fail, then the acids in the tanks will react with the concrete in the vaults, releasing large amounts of radioactive gases into the atmosphere.

Zollweg and Sprenke's 1995 report titled *Review of INEL Seismographic Networks and Seismic Hazard Program*, also challenged DOE's seismic monitoring and characterization. DOE's seismic instruments are set so high that only two earth quakes were registered in the last 20 years.

Zollweg notes that in 1994 alone there were five earthquakes with magnitude greater than 5 within 150 km of INL that were not recorded on DOE instruments yet were felt on INEL. These unregistered quakes include the 5.9 Draney Peak earthquake of 3 February 1994 and the 5.1 Challis earthquake of 7

June 1994. [OPTR 95-01@52]

Consequently the available data understates the seismic activity in the region and draws into question DOE's claim that the INL lies in an aseismic zone. The report further criticizes DOE for not including multiple fractures within a given seismic event as is more common. The researchers emphasize the current knowledge gained from "surprises" such as the 1994 Los Angles and the 1995 Kobe, Japan quakes because these cities sit on alluvial sediments (like INL) which earlier were thought to attenuate or cushion shocks from underlying ruptures, but which actually magnify the shocks at the surface. Zollweg further challenges DOE censure of their own seismologist Ivan Wong's subsequent work for political reasons, because the department did not like Wong's findings. Zolweg and Sprinke's conclusions list the following safety issues:

"1.) Characterization of the maximum credible earth quake (MCE) on the southern Lemhi and Lost River faults. It is our opinion that the Mw 7.0 MCE chosen in [DOE's] Wong et al. (1992) is not sufficiently conservative in view of the faulting behavior of typical large Basin and Range province earthquakes. We recommend the Lemhi fault MCE be chosen on the basis of simultaneous rupture of three to four segments, and the Lost River fault MCE be chosen on the basis of rupture of the entire length of the Lost River fault south of the southern terminus of the faulting in the 1983 Borah Peak earthquake. Directivity effects should be considered as part of the analysis, since rupture propagation on these faults in the general direction of INEL could potentially produce larger ground motions at INEL than bilateral rupture or unilateral rupture away from the INEL.

"2.) Amplification characteristics of the basalt-sediment inter-beds underlying the northern part of the INEL. Theoretical modeling suggests that the inter-beds may attenuate surface motion, but this work has largely been based on 1-dimensional calculations and we believe that 3-D effects have not been adequately modeled. We recommend that the inter-bed effects on seismic waves be directly measured, taking advantage of an existing deep borehole which is known to penetrate into the rocks below the inter-bedded stratigraphy." [OPTR 95-01@69-70]

Complete seismic monitoring, documentation and analysis must be independently developed by the State in addition to a study that addresses the recurrence rates of these large earthquakes and the impact on INL facilities such as the high-level waste tanks. Seismic analysis of INL reactors also documents non-compliance with current codes.

Also see Section I.J.1 NRF FEIS Incomplete Seismic Vulnerabilities page 38 for more information on NRF Seismic hazards.

The Advanced Test Reactor (ATR) vessel "spacer bolt loads and support skirt radial bolt loads exceeded allowable values." Loads on the support skirt bolts were calculated at 76 kips and the yield load of the bolts was 43 kips. [RE-A-78-038 @ 16&18]

The ATR's Emergency Firewater Injection System (EFIS) would be inoperable during a design basis earthquake. The purpose of the EFIS is to inject firewater into the reactor core to prevent irradiated fuel elements from being uncovered in the event of a loss-of-coolant accident or a complete loss of coolant flow during reactor operation or shutdown.

The ATR was built in 1963 in accordance with national building code standards applicable at that time, but it was not built to earthquake standards. Because the EFIS does not meet current seismic codes and because of the potential firewater piping hanger failure, engineers declared the system technically inoperable. This means the system is functional but documentation does not support operability for the full range of intended safety functions (i.e. earthquakes). [OE-95-35]

The ATR and its SNF storage canal also has no containment building currently required around commercial nuclear reactors to contain radioactive releases in the event of an accident. The Navy is claiming the ATR is exempt from NRC standards. The ATR continues to operate today - primarily conducting materials testing for the Nuclear Navy.

"The problem has been that the analysis to assure that equipment is adequately designed typically has not been followed through end-to-end. The more frequent seismic events, say one-in-one-hundred-year events, generate smaller forces for equipment to withstand. Only the essential equipment for assuring safety need meet seismic design criteria. Low hazard facilities need only be designed to withstand these

lower intensity earthquakes. The Advanced Test Reactor is a DOE hazard category I reactor.3

"It is required to withstand a higher intensity earthquake, analogous to a commercial reactor because of its releasable curie inventory. Equipment essential for safety during or following a seismic event is required to be capable of withstanding a large seismic event, the size of which is determined by the INL's seismic characterization for ATR's precise location and DOE regulations." [1]

"The Engineering Test Reactor (ETR) now closed, primary coolant system was designed in the late 1950's with no consideration for seismic loading. The system was designed according to standard piping practices of that time and presently does not meet certain criteria in the ASME Boiler and Pressure Vessel Code." [ER-E-77-102 @ 1] The Materials Test Reactor (MTR) also closed spent fuel storage facility has been cited by DOE investigators as extremely vulnerable to seismic activity. [Spent Fuel Working Group 11/93]

Analysis of the ETR building revealed that it also did not meet structural code. Among many violations was a concrete block wall that was over-stressed by a factor of 2.5. [RE-A-77-027@21]

None of INL's reactor buildings can contain radiation in the event of an accident. Current NRC standards require a sealed reinforced concrete containment building with the structural capacity to withstand explosions and contain radiation emissions from the reactor vessel and/or related equipment. Both the ETR and the MTR have been D&D but operated in unsafe condition for decades putting the public at risk.

The ICPP Calcine silos are also at risk according to a 1977 INEL Environmental Impact Statement. "The occurrence of an earthquake of magnitude near 7.75 (Richter Scale) with an epicenter at the Arco Scrap fault, about 20 mi. west of the ICPP, would produce a maximum credible ground acceleration at the storage area of above 0.33 g (the design basis earthquake)." ... "The bin anchor bolts possibly might shear, and with anchor bolt failure some damage may be inflicted on bin vent piping above the bins." ... "No damage would be anticipated- if the ground acceleration was 0.18 g." [ERDA-1536@II-95] These bins must be continuously cooled due to the heat generated by the radiation which the cooling coils keep at 480^0. Bin Set # 1 is in the worst shape and must be prioritized for D&D.

An October 1992 DOE report prepared by Westinghouse Nuclear has generated an investigation about the safety of key facilities used to store high-level radioactive waste at INL. The report questions the ability of the ICPP-603 Underwater Fuel Storage Facility to withstand an earthquake. In the event of a quake, heavy corrosion in the facility could create leaks into the environment, the report said. Corrosion on the fuel storage baskets and the yokes they hang from may cause a criticality (an accidental uncontrolled nuclear chain reaction). Because the facility outlived its design life, equipment failures were frequent and costly. Under pressure, DOE finally emptied the CPP-603 SNF storage pool but the decades of leaks from the unlined pool significantly contaminated the underlying aquifer.

WINCO's Standing Root Cause Committee Report 6/14/93 compiled by S.P. Gearhart outlines over 20 years of knowledge of ICPP-603 safety/criticality SNF storage problems. The report even documents many remediation projects to correct the same problems that were funded but the work was never done; and the government never followed up to confirm completion of the work. "Even when the operating contractor was able to secure funding, the funds were spent on FDP startup and other fuel reprocessing facilities, and fuel storage did not receive much priority." [SPG-31-93 @ 15]

Irradiated Fuel Storage Facility; Though DOE has moved the spent fuel out of the CPP-603 pools, the Irradiated Fuel Storage Facility in CPP-603 remain in use as a dry fuel storage area. Public pressure forced DOE in 1998 to construct a concrete sheer wall in CPP-603 along with some modifications to the overhead cranes that move the fuel from trucks to the storage space but there is no

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[1] Tami Thatcher, May 2015 Volume 26 Number 4 *Weakest Link Matters in Seismic Assessment,* Hazard category I with a class A reactor is the highest Department of Energy hazard designation. But don't ignore Hazard category II facilities—they span the gamut of releasable hazard but cannot be categorized as higher than category II because they are not nuclear reactors. The Advanced Test Reactor is Department of Energy regulated and U.S. Nuclear Regulatory regulation and oversight do not apply. The Defense Nuclear Facility Safety Board visits some INL facilities when their mission is deemed to involve defense material. DNFSB currently deems ATR outside its scope.
http://www.environmental-defense-institute.org/publications/News.15.May.Final.pdf

mention of any modification to the inadequate ventilation or fire suppression systems. Old SNF represent a significant hazard due to deterioration of cladding caused by irradiation.

DOE's 1995 seismic analysis of existing facilities postulates an earthquake magnitude of 7 on the Richter scale generating an acceleration of 0.24 g. However, a DOE's 1995 Natural Phenomena Hazards Mitigation Conference in Denver generated a contradictory report by Ivan Wong titled *Microzonation for Earthquake Ground Shaking at the INL* which shows accelerations as high as 0.30 g on their probabilistic seismic hazard map contour through the RWMC, TRA, and NRF. [Wong @ 27]

These findings are more in line with the previously discussed Zollweg and Sprenke conclusions. These differences in interpretations are not just an academic exercise when catastrophic radioactive releases into the environment are at stake.

Building 607 at INL's Test Area North previously held the core debris from the wrecked TMI reactor in pools of water yet the building did not meet current standards for seismic performance, compliance with electrical code, ventilation and filtration systems, and other requirements which would be applicable to the storage of nuclear fuels. The pool now closed, built in 1954, was also unlined and had no leak detection system. Because of these deficiencies, it was stipulated in the 1995 court settlement that the Three Mile Island fuel in the pool be moved out by 2001.[DOE/EA-1050@4-5]

The Naval Reactors Facility Expended Core Facility built in 1957 does not meet current seismic building standards. Water Pits 1, 2, and 3 were only constructed to "Zone 2 earthquake requirements which were judged to be appropriate under the USGS's classification of the area at the time [1957] of their construction." [INL DEIS @ B-18]

Subsequent (1979) USGS requirements for INL raised that standard to zone 3, then in 1982 INL was gerrymandered back to a zone two. As previously discussed, it is an open debate as to whether the zone three should be reinstated. Since the superstructure of ECF was built in 1957, it too does not meet code requirements.

Earthquakes in INL Region between 1900 and 1973*

Magnitude Richter Scale	Distance in Miles from INL Site 50 - 60 Miles	60 - 70 Miles	70 - 80 Miles	80 - 100 Miles
5.8 to 4.9	0	0	0	3
4.8 to 3.8	1	2	3	15

*** 1983 Borah Peak quake with its epicenter 40 miles from INL registered 7.3, the 1994 Draney Peak of 5.9 and the 1994 Challis with 5.1 on the Richter Scale within 60 miles.**

Naval Reactor Facility (NRF) Seismic Vulnerabilities

The EIS failed to adequately assess the Expanded Core Facility (ECF) seismic vulnerabilities.

The FEIS states: "**The ECF water pools have never undergone a complete refurbishment and have not been upgraded to current seismic standards."** [2] [Pg. S-6]

Despite this statement, NRF intends to continued use of the ECF for decades and does not specify exactly what modifications will be made and what independent seismic assessment will be made to demonstrate compliance.

FEIS states: "Seismic Hazards Refurbishment Period: There would be **moderate** impacts from

[2] Final Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling, October 2016, DOE/EIS-0453-F, Pg. S-9, herein after referred to as FEIS.

seismic hazards until refurbishment activities are complete. Activities during the refurbishment period would improve the building's ability to withstand vibratory ground motions from seismic activity. Post-Refurbishment Operational Period: There would be small impacts from seismic hazards since the refurbishment actions would improve the building's ability to withstand vibratory ground motions from seismic activity." [Pg. S-33]

FEIS states: "Seismic Hazards: Differences in impacts from seismic hazards from the alternatives are related to the ability to withstand vibratory ground motions under each alternative. Since there would be no additional refurbishment or upgrades to ECF for the No Action Alternative, the facility and supporting infrastructure **would continue to degrade for a period of 45 years**. During the refurbishment period of the Overhaul Alternative, **to the extent practicable,** infrastructure and equipment would be refurbished or designed to the appropriate natural phenomena hazard category to withstand vibratory ground motions. "During the **construction and transition periods** of the New Facility Alternative, **there may be upgrades or refurbishments to ECF,** to ensure operations continue in a safe and environmentally responsible manner**.** [Pg.S-72]

What do the above statements: "to the extent **practicable**" and "there **may be** upgrades or refurbishments to ECF" mean? Obviously, this is slippery non-committal language that has no business in this FEIS and must raise RED flags to EPA/IDEQ regulators.

The above FEIS statement contradicts the fact that NRF intends to continue ECF operations for over 3 additional decades. Additionally, the FEIS fails to offer requisite detail on what exactly these ECF "upgrades" will be.

"During the **refurbishment period** of the Overhaul Alternative**, to the extent practicable**, infrastructure and equipment would be refurbished or designed to the appropriate natural phenomena hazard category to withstand vibratory ground motions."

Again, what do the above statements: "to the extent **practicable**" and "there **may be** upgrades or refurbishments to ECF" mean? Obviously, this is slippery non-committal language that has no business in this FEIS and must raise RED flags to regulators. Repeating a false statement over and over does not make it true.

FEIS states: "During the construction and transition periods of the New Facility Alternative, there may be upgrades or refurbishments to ECF, to ensure operations continue in a safe and environmentally responsible manner. During the transition and new facility operational periods, the structures, systems, and components in the new facility would be designed to the **appropriate natural phenomena hazard category to withstand vibratory ground motions."** [FEIS Pg. S-72]

Only careful reading reveals that only the NEW Facility portion covered in this EIS will be built to "appropriate natural phenomena hazard category to withstand vibratory ground motions" cleverly giving the impression that the ECF is included.

B. Seismic Vulnerability of Storing Highly Enriched SNF in ECF

The FEIS states: "Naval nuclear fuel is highly enriched (approximately 93 weight percent to 97 weight percent) in the isotope uranium-235 (235U). As a result of the high initial uranium enrichment, very small amounts of transuranic radionuclides are generated by end of life when compared to commercial spent nuclear fuel." [Pg.1-3]

This Navy high burnup SNF ECF is the most hazardous material in the world requiring deep geological disposal for hundreds of thousands of years due to the long-lived radio-isotopes produced in nuclear reactors. The current ECF inventory of ~400 assemblies constitutes a significant unregulated hazard in the event of accidental loss of canal coolant water.

"Since the 1990's, U.S. reactor operators are permitted by the U.S. Nuclear Regulatory Commission (NRC) to effectively double the amount of time nuclear fuel can be irradiated in a reactor, by approving an increase in the percentage of uranium-235, the key fissionable material that generates energy. In doing so, NRC has bowed to the wishes of nuclear reactor operators, motivated more by economics than spent nuclear fuel storage and disposal. Known as increased "burnup" this practice is described in terms of the

amount of electricity in gigawatts (GW) produced per day with a ton of uranium." [3]

"Given these uncertainties the U.S. Department of Energy (DOE) and the NRC have provided general estimates of the radionuclide content of spent nuclear fuel based on current and previous burnup assumptions. According to DOE the estimated average long-lived radioactivity for a typical PWR and BWR assembly having lower burnup at the time of geological disposal are 88,173.69 curies and 30,181.63 curies respectively. 29 For current burnups the NRC estimates that the post discharge radioactive inventory of spent fuel for a typical PWR and BWR assemblies are 270,348.26 curies and 127,056.67 curies respectively.[4] **Approximately 40 percent of the total estimated radioactivity for lower and high burnup is Cs-137**." [5] [emphasis added]

The FEIS ECF accident source terms do not list Cs-137.[6] This represents another significant deficiency in this FEIS. The Navy uses zirconium clad fuel that adds to storage hazards.

"Zirconium cladding of spent fuel is chemically very reactive in the presence of uncontrolled decay heat. According to the National Research Council of the National Academy of Sciences the buildup of decay heat in spent fuel in the presence of air and steam: " is strongly exothermic – that is, the reaction releases large quantities of heat, which can further raise cladding temperatures… if a supply of oxygen and or steam is available to sustain the reactions. The result could be a runaway oxidation – referred to as *a zirconium cladding fire* – that proceeds as a burn front (e.g., as seen in a forest fire or fireworks sparkler)...As fuel rod temperatures increase, the gas pressure inside the fuel rod increases and eventually can cause the cladding to balloon out and rupture.[original emphasis]" [7]

The FEIS states: "Naval spent nuclear fuel consists of solid metal and metallic components that are nonflammable, highly corrosion-resistant, and neither pyrophoric, explosive, combustible, chemically reactive, nor subject to gas generation by chemical reaction or off-gassing. Naval spent nuclear fuel is primarily from pressurized water reactors (PWRs)." [FEIS Pg. 1-3]

C. Seismic Vulnerabilities of ECF Degraded Concrete Basin

There are some crucial unknowns the FEIS failed to assess.

1. Is the ECF basin concrete already to degraded to allow continued operation?
2. What radiation cumulative level has the ECF basin been exposed to now and in 10 years? 10 x E 10 rad? More? Less?
3. Will the fuel in the ECF (or some fraction of fuel) melt/burn if water is removed and the fuel is uncovered?
4. Will the concrete or structural materials above the ECF actually fail if temperatures rise because of fuel heat up? Interesting that it has not been brought up as an issue before, but perhaps that is because the fuel melting temperature of fresher fuel assured fuel melt before such structural damage.

Defense Nuclear Facility Safety Board conducted a review of the newer INL/INTEC CPP-666 SNF Basin concrete foundation. "The [Fuel Storage Area] FSA Pool Structures is a passive design feature of the FAST facility. **Additional calculations performed to increase the allowable floor loading to support the FSA Reracking Project indicated that the original design objective to allow an empty**

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[3] Robert Alvarez, Memorandum: High Burnup Spent Power Reactor Fuel, : December 17, 2013, citing : Foot Note 29: U.S. Department of Energy, Final Environmental Impact Statement, for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, 2002, Appendix A, Tables A-7, A-8, A-9, A-10, (PWR/ Burn up = 41,200 MWd/MTHM, enrichment = 3.75 percent, decay time = 23 years. BWR/ Burn up = 36,600 MWd/MTHM, enrichment = 3.03 percent, decay time = 23 years.)

[4] Alvarez citing: U.S. Nuclear Regulatory Commission, Characteristics for the Representative Commercial Spent Fuel Assembly for Pre-closure Normal Operations, May 2007, Table 16, p.44-45. http://pbadupws.nrc.gov/docs/ML0907/ML090770390.pdf

[5] Robert Alvarez, Memorandum: High Burnup Spent Power Reactor Fuel, : December 17, 2013, Pg. 5

[6] FEIS Pg. F-35

[7] Robert Alvarez, Memorandum: High Burnup Spent Power Reactor Fuel, December 17, 2013, pg. 8.

pool to be adjacent to a water filled pool resulted in overstresses during the [Design Basis Earthquake] DBE." [8] [DFNSB Pg. A-4]

FEIS fails to fully analyze the ECF refurbishing part that includes empting sections so epoxy leak prevention remediation can proceed. Calculations of shifting ECF SNF on the concrete degraded basin foundations ability to withstand the "overstress" concurrently with a DBE are absent.

It is highly likely that the ECF concrete walls have received an aggregate gamma ray dosage far in excess of that necessary to severely degrade the concrete, thus increasing seismic vulnerabilities. Maintaining ECF water levels should a significant seismic event (earthquake) occur are problematic. The FEIS fails to fully analyze these fundamental issues in the Hypothetical Accident 4.13.2.2.

For continuously wetted concrete (no stainless steel liner) an aggregate dose of 10 x E10 rad (10 x E8 gray) is the limit. For dry concrete the limit is not known. The few pieces of data available from the X10 reactor in Oak Ridge, Tennessee and the Temelin reactor in the Czech Republic suggest that the allowable dose to avoid structural degradation and failure is 500 to 2,000 times lower than for wetted concrete (i.e., 5 x 10E6 rad).

The catastrophe hazard from an ECF basin drain down event is more than extreme. Such an event must be prevented at any cost. Once a drain down begins it cannot be stopped. Once the fuel is exposed no human or robotic response is possible - of any kind. A current example is Japan's Fukushima reactor/SNF storage disaster.

The accident will then proceed to its ultimate termination independent of human intervention. Temperatures inside the ECF structure will likely rise to levels sufficient to cause the concrete to fail and the building to crumble in on itself. The human exclusion zone for direct radiation exposure will likely be 1-2 km in all directions. No access will be possible in this zone for decades. Once fuel fails and radioactive atmospheric releases that zone will be pushed farther out (likely much farther out). Access to respond to the event may not be possible in or through that zone for centuries.

FEIS must provide independent engineering assessments of ECF basin concrete. Alternatively, using civilian fuel (since Navy fuel details are classified) as a surrogate; what is the concrete heat profile and rad profile of used civilian fuel? How far is it from the walls and floors of the basin? Then do some estimates of shielding and voile you have estimates of dose. Doing that correctly requires details about the fuel, and a complex set of radiation calculations that have a lot in common with optics problems. Gamma rays are light after all. The fuel is opaque to it, as are the water and concrete. Some of it is absorbed and heats the fuel, water and concrete. Several different interactions occur that shift the energy spectrum and generate secondary radiation. The most accurate way to assess all of this is to actually measure it.

What you will likely find is that the surface of the concrete probably exceeded 10 x E10 rad after 10-20 years. It is likely now that the concrete 6-10 inches in has exceeded that same dose. The concrete 'paste' likely has little to no strength in 6-10 inches from the surface.

The temperature issue is different. So long as there is some cooling and the fuel is over 20 years old, there is not much heat to remove. If the basin water is lost, during an earthquake or severe leak, the rad field can be extreme. That prevents human entry. Lacking human entry the systems fail. When ventilation is lost heat then builds up having only convective and radiative cooling to keep things under control. [9] With limited ventilation, the temperatures inside the structure will rise substantially. If newer fuel is present, this could get out of hand quite quickly creating a second barrier (after the lethal rad fields) to human entry. The potential then is that following a basin drain down that uncovers the fuel that the accident progresses of its own accord to complete loss of control of the basin and failure of the fuel. It is likely that no recovery will ever be possible at that point. The accident proceeds to final completion

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[8] DNFSB Recommendation 2000-2 INEEL Priority Facility Phase I Safety Class, Ventilation and Fire Protection Systems Assessment Report, Pg. A-4.

[9] A DNFSB review of the newer INL/INTEC CPP-666 Fuel Storage Area (FAST) water basin found "[T]he Confinement Ventilation System is degrading due to facility aging. This degradation could result in future operational downtime, radiological contamination and personnel exposure." DNFSB Recommendation 2000-2 INEEL Priority Facility Phase I Safety Class, Ventilation and Fire Protection Systems Assessment Report, Executive Summary.

(whatever that is) entirely outside of human ability to influence it.

The concrete dose serves to heat the concrete failing it prematurely. This is well known. And it served to hide the insidious damage to the concrete, as that is waived away as being all thermal damage, and then assessing that the concrete in the basin hasn't seen high heat, so it will not fail. For instance, the rad dose damage gets ignored. There are also an equally large but still handful of data points for dry concrete exposed to radiation. That data was thrown out in developing the standards for what radiation dose concrete can withstand. The data was discarded on the presumption that the early weakening was attributable to heat. The experience at Temelin and X-10 show that to be wrong. The concrete wasn't heated.

Another way to think about this is that at a microscopic scale, absorbed radiation heats the concrete at nearly the atomic level. The heat damage is then limited to a small volume. But continue doing this over 50 years in a large SNF ECF basin and the problem becomes a stochastic one of adding up all of the random little damages into one large failure. This can lead to a large uncontrollable leak and extended loss-of-coolant.

Yet another way to consider it is that the radiation serves to boil out the water from the cement paste that forms the backbone of concrete. When the concrete is moist there is water immediately available to cool the local heating and/or to replace the lost water. When the concrete is dry (< about 11% water) these effects are not enough and waters of hydration are lost from the paste to migrate out of the concrete. The paste then chemically changes and falls apart as damage accumulates.

One of the papers on this considered two different dose rates and times to accumulate the same aggregate dose or different doses. What they observed was very interesting. The time until the concrete was weakened remained the same despite the differing dose rates. In other words, the effect seemed to be caused by some critical radiation insult and then the passage of time. This is hugely concerning as it brings into question the entire safety basis and the possibility that the damage is essentially done in the first few days. It then just takes time for the basin concrete to fail. The FEIS acknowledges ECF basin concrete degradation.

Section I.J.2. INL Volcanic Hazards

There are also volcanic hazards at INL. Craters of the Moon, a large volcanic flow, next to the INL site was formed 2,000 years ago - a mere blink of an eye in geologic time. Volcanic cones also exist on the INL site. A complete analysis of the potential for silicic ash-flow sheet volcanism in the INL region was not incorporated in 1995 INL EIS studies. Silicic ash-flow sheets represent a sizable portion of the geologic history of the Snake River Plain and are characterized by the most violent eruption histories. INL is in the middle of the Snake River Plain (SRP). Flying over the SRP, the volcanic flows dominate hundreds of square miles making it look like a moonscape.

To put these seismic and volcanic hazards into perspective, two time frames and facility categories should be analyzed: short-term earthquake hazards on structurally deficient reactors and high-level radioactive waste storage facilities; and long-term hazards of volcanic activity on permanently buried radioactive waste much of which have a half-life of 24,000 years. The eruption of Mt. St. Helens in the 1980's along the Oregon/Washington border along with the Borah and more recent Challis earthquakes would give any reasonable person concern over the wisdom of leaving such radioactive hazards at INL. A National Park Service and US Geological Survey sponsored a study conducted by John Byrd and Bob Smith who said " It looks like the Teton Fault is either on schedule or considerably overdue for a major ground-rupturing earthquake." The quake would measure at least 7.0 and not more than 7.6 on the Richter Scale. [Idaho State Journal(b),AP 12/7/93]