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December 20, 2021

RE: Comments on Idaho Department of Environmental Quality (DEQ) Modified Hazardous Waste Storage and Treatment Facility Partial Class 3 Permit for the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Laboratory, Permit Number EPA ID No. ID4890008952 Liquid Waste Management System and the Integrated Waste Treatment Unit (IWTU). DEQ Public Notice of Intent 11/19/21, Docket Number 10HW-2103.

Sent via email to: Brian English http://deq.idaho.gov/public-information/public-comment-oppertunities/

The Environmental Defense Institute has always advocated for safe treatment of the high-level sodium bearing liquid waste in the best and most appropriate treatment in compliance with Idaho/DOE Settlement Consent Order. That said, it appears that DOE is again trying to take short cuts and not fully complying with applicable laws.

DEQ has allowed DOE for many years to "boot-strap" new deadly waste operations like the IWTU onto old Process Equipment Waste Evaporator (PEWE) permits and thereby avoid the otherwise full legal Resource Conservation Recovery Act (RCRA) and Clean Air Act (MACT) permitting process. [1] DOE's IWTU is required as a matter of law to obtain a RCRA and MACT permit as a new major source facility and not be engrafted as a modification onto the current application that is decades old. [2] This is a jurisdictional issue that requires resolution before the IWTU can receive any legitimacy as a RCRA facility. [3]

The DEQ, with EPA Region-10's concurrence, illegally relies on the decades old RCRA permit for the Process Equipment Waste Evaporator (PEWE) and attempts to "bootstrap" **new separate operations in separate buildings** into this new permit modification. Current EPA regulations restrict permit modification to **existing** permitted operations. [4] Therefore, DEQ approval of this new permit modification is bogus because there are no original permits for the IWTU, High-level Liquid Waste Evaporator and Liquid Effluent Treatment & Disposal. These operations needed to obtain individual RCRA permits as new facilities because they were not in existence before 1986. [5] Moreover, the deadline for DOE

[1] Code of Federal Regulations (CFR), National Emission Standards for Hazardous Air Pollutants, Maximum Achievable Control Technology (MACT) Standards for Major Sources 40 CFR 63.40 through 63.44

[2] DEQ Updated Listing of INL RCRA documents 1/17/07, INTEC Permitting, page 29-30, shows the last full RCRA permit for the Process Equipment Waste Evaporator.

[3] 40 CFR 270.42

[4] 40 CFR 270.42(a)(i) Subpart D Changes to Permit. 6/7/05

[5] Construction for the High-Level Liquid Waste Evaporator (HLLWE) at the Idaho National Laboratory was initiated in 1993 and operation of the HLLWE as a new facility began in 1996. The HLLWE has processed over 4

compliance with the Clean Air Act/NESHAP/MACT standards for these operations was 6/29/98. [6] Why? Because even Idaho knows that Interim Status only applies to RCRA operations operating prior to 1986.

EPA/OIG states; "Interim status is a temporary designation, but some units have existed for as many as 25 years without formal issuance or denial of a permit, or other regulatory controls." [7]

Treatment & Disposal. These operations needed to obtain individual RCRA permits as new facilities because they were not in existence before 1986. Moreover, the deadline for DOE compliance with the Clean Air Act/NESHAP/MACT standards for these operations was 6/29/98. [8]

Construction for the High-Level Liquid Waste Evaporator (HLLWE) at the Idaho National Laboratory was initiated in 1993 and operation of the HLLWE as a new facility began in 1996. The HLLWE has processed over 4 million gallons of high level radioactive liquid and mixed hazardous wastes without a RCRA permit. DOE is required but has failed to submit an application for a RCRA permit for the HLLWE. The HLLWE has operated at all times without a RCRA permit and without interim status [9] and 40 CFR 63.42. Also see EPA Office of Inspector General 3/9/05 Evaluation Report "Substantial Changes Needed in Implementation and Oversight of Title V Permits If Program Goals Are to Be Fully Realized"

There is No Disposal Path-Forward for the ITWU Waste

This Permit also violates the Idaho/DOE Settlement Agreement/Consent Order and Notice of Noncompliance requirements for "road-ready" disposable waste that will meet with "waste acceptance criteria" (WAC) for a final disposal site. [10] To-date, the waste product that best meets these WAC requirements is vitrified glass/ceramic. Yet DOE rejected direct vitrification in its Idaho High-Level Waste and Facilities EIS. [11] Moreover, there is no final disposal "path-

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million gallons of high-level radioactive liquid and mixed hazardous wastes without a RCRA permit. DOE is required but has failed to submit an application for a RCRA permit for the HLLWE. The HLLWE has operated at all times without a RCRA permit and without interim status. See Environmental Defense Institute, et al., Notice of Intent to Sue DOE, 7/9/02, available at; http://environmental-defense-institute.org

[6] 40 CFR 63.42. Also see EPA Office of Inspector General 3/9/05 Evaluation Report "Substantial Changes Needed in Implementation and Oversight of Title V Permits If Program Goals Are to Be Fully Realized"

[7] USEPA Office of Inspector General, 12/4/06, EPA's Management of Interim Status Permitting Needs Improvement to Ensure Continued Progress, Report No. 2007-P-00005.

[8] Construction for the High-Level Liquid Waste Evaporator (HLLWE) at the Idaho National Laboratory was initiated in 1993 and operation of the HLLWE as a new facility began in 1996. The HLLWE has processed over 4 million gallons of high level radioactive liquid and mixed hazardous wastes without a RCRA permit. DOE is required but has failed to submit an application for a RCRA permit for the HLLWE. The HLLWE has operated at all times without a RCRA permit and without interim status. See Environmental Defense Institute, et al., Notice of Intent to Sue DOE, 7/9/02, available at; http://environmental-defense-institute.org

[9] See Environmental Defense Institute, et al., Notice of Intent to Sue DOE, 7/9/02, available at; http://environmental-defense-institute.org

[10] U.S. District Court for the District of Idaho in USA v. Batt, Civil No 91-0054-S-EJL, Consent Order, 10/17/95.

[11] Idaho High-Level Waste and Facilities Disposition, Final Environmental Impact Statement, September 2002, DOE/EIS-0287.

forward" for the ITWU waste because WIPP Waste Acceptance Criteria specifically "excludes" this waste generated from INTEC Tank Farm. Given the inevitable long-term storage of these wastes at INL (in a USGS recognized flood zone) until a permitted final disposal site is established, only the vitrified glass waste will pose the least significant leach of contaminates hazard into the underlying Snake River Aquifer.

Don Hancock, Southwest Research and Information Center (SRIC) Nuclear Waste Program Director states: "Waste from the [high-level waste] HLW tanks at INL is not bound for WIPP, whether it's called [remote handled] RH or [contact handled] CH TRU. The RH waste that's coming to WIPP is from Argonne-East, not from INTEC.

"The WIPP permit still has the following prohibition: *II.C.3.h. Excluded waste - TRU mixed waste that has ever been managed as high-level waste and waste from tanks specified in Permit Attachment B are not acceptable at WIPP unless specifically approved through a Class 3 permit modification. Such wastes are listed in Table II.C.3.i below.*

The DEQ's Treatment Facility Partial Class 3 Permit for the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Laboratory is inadequate given the importance of this major new operation Integrated Waste Treatment Unit (IWTU) due to the fact that all the associated operations connected are **not** included or adequately referenced as Liquid Waste Management System listed below.

"The LWMS is composed of numerous permitted accumulation tanks, ancillary piping and four primary treatment units including:

* "The process Equipment Waste Evaporator (PEWE) a closed loop evaporator system with the condensed overheads and still bottoms held for further treatment.
* "The Liquid Effluent Treatment and Disposal unit employs fractionation columns to treat the PEWE overheads, recovering a nitric acid stream that is reused.
* "The Evaporator Treatment System, located in CPP-659 further concentrates higher activity liquid wastes.
* "The integrated Waste Treatment Unit (IWTU) is a new steam reformer system built to convert the remaining (previously classified as high-level waste) sodium bearing tank farm waste into a solid form. The storage part of the IWTU includes dry solids and indoor waste pile storage associated with managing the treated waste." [12]

EPA Region 10 relies on CFR 270.72 "Subpart G Interim Status, Changes During Interim Status" in its ruling. However, EPA fails to document how these new INL operations were under Interim Status. Moreover, DEQ's "Intent to Permit" IWTU contains no apparent reference to Interim Status and only characterizes it as a "Partial Permit."

According to DOE's IWTU facility description, "Approximately 900,000 gallons of mixed liquid waste, containing both hazardous and radioactive components, are stored in three 300,000-gallon

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[12] Public Notice: Intent to Renew Permit, Idaho Department of Environmental Quality, 8/18/14.

tanks at the Tank Farm Facility at the Idaho Nuclear Technology and Engineering Center (INTEC). This waste is collectively known as sodium-bearing waste. A steam reforming process was selected to treat this waste. The specific steam reforming technology incorporated into the Integrated Waste Treatment Unit (IWTU) is a dual fluidized-bed process that uses superheated steam, carbon, and other additives to convert the sodium-bearing waste into a solid, granular treatment product that is packaged into canisters suitable for ultimate disposal. The process is named the Integrated Waste Treatment Unit because two fluidized-bed steam reformers are integrated into a single treatment process with a common air pollution control system." [13]

However in the same DOE report it states: "The applicant has requested to reduce the annual feed rate of the IWTU from 1,236,000 gallons per year to 1,114,000 gallons per year. The new annual feed rate ensures that the NOx increase of the IWTU project maintains below 40 tons per year, the significant level for NOx for a major source modification. Based on newly available information on NOx carryover from the Denitration and Mineralization Reformer (DMR), reduction of the annual feed rate becomes necessary to avoid prevention of significant deterioration (PSD) review for NOx for the IWTU project.... This permitting action is a revision to Permit to Construct (PTC) No. P-060520 issued on May 3, 2007. This permitting action does not qualify as "modification" in accordance with IDAPA 58.01.01.006.63 because there is not physical change in, or change in the method of operation of, a stationary source or facility, and the source has not completed construction yet. Therefore, when conducting emissions estimation, ambient impact analysis, and regulatory analysis for this permitting action, the applicant is required to look at emissions from the entire IWTU project rather than only look at emissions increase due to newly available information and specifications change to not yet built equipment." [14] [emphasis added]

The difference between original and publicly announced 900,000 gal. IWTU process through-put and 1,236,000 gallons per year is 336,000 gallons. Neither DOE nor DEQ offer any explanation of where and what the characterization of these additional 336,000 gallons is.

DOE's report 3.1 Emission Unit and Control Device Table 3 Emissions Unit(s) / Process(es) Emissions Control Device Emissions Point IWTU stack consists of:

a. Process HEPA Filter Stack height: 120 ft
b. Denitration and Mineralization Reformer Exit diameter: 5 ft
c. Carbon Reduction Reformer (CRR) System Exit temperature: 144°F
d. Treatment Product Transfer and Loadout System Exit velocity: 59 ft/second (estimated) [15]

The above listing does not include Liquid Waste Management System (LWMS) Evaporators that go out main stack. **Why?**

DOE's Feed Report states: "Based on the 2016 schedule, the new tanks will contain approximately 1,025,000 gallons of concentrated waste plus 75,000 gallons of solids slurry at the

[13] U.S. Department of Energy Idaho Operations Office (DOE-ID), Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center Integrated Waste Treatment Unit Facility ID No. 023-00001, August 31, 2009 Section 1.1 Facility Description.
[14] Ibid: Section 2.1 Application Scope
[15] Ibid: Section 3.1 Table 3 Emission Unit and Control Device

start of the vitrification facility hot operation in June 2016. During waste treatment, about 36,000 gallons of concentrated waste (NGLW [newly generated liquid waste] plus final heel pump-out from WM-187, -188, -189 and -190) are added to the New Tank Farm. The vitrification facility will process about 1,060,000 gallons of concentrated liquid waste plus the 75,000 gallons of slurry. For this scenario, the treatment facility will need to be designed for two types of feed, the concentrated liquid waste that will vary slightly in compositions due to additions of waste during the campaign, and the heel solids slurry." [16]

Relevant Regularity Statutes DOE claims do not apply:

4.7 NESHAP Applicability (40 CFR 61)

This permitting action does not trigger any new NESHAP requirements.

4.8 MACT Applicability (40 CFR 63)

This permitting action does not trigger any new MACT requirements.

4.9 CAM Applicability (40 CFR 64)

This permitting action does not trigger any new CAM requirements.

RCRA Process Vent Classification

The permit claims "The Process Equipment Waste Evaporator (PEWE) off-gas is processed through both the Building 604 Vessel Off-Gas System and the Process Atmospheric Protection System (APS) in Building 649, prior to discharge to the INTEC main stack. The PEWE vent does not meet the definition of a process vent at IDAPA 58.01.008 [40 CFR.1031]. Therefore, the air emission standards for process vents do not apply." [Page 35 and 36]

The permit also claims "The Evaporator Tank System (ETS) off-gas is processed through both Building 659 Process Off-gas System and the Process Atmospheric Protection System (APS) in Building 649, prior to discharge to the INTEC main stack. The PEWE vent does not meet the definition of a process vent at IDAPA 58.01.008 [40 CFR.1031]. Therefore, the air emission standards for process vents do not apply." [Page 36] **This represents an unsubstantiated switch from the previous ILWMS Permit that acknowledged the PEWE as being a "process vent" operation.**

The DOE HLW &FD EIS (DOE/EIS-0287D) page 1-13 (Figure 1-6) and DOE/EIS-0287 Final page 2-11 (figure 2-4) clearly shows the High-level Liquid Waste Evaporator also housed in the New Waste Calciner building, and now called the ETS, emissions go directly to the INTEC main stack. [17]

40 CFR 1031 states that "Process vent means any open-ended pipe or stack that vented to the atmosphere either directly, through a vacuum producing system, or through a tank (e.g., distillate receiver, condenser, bottoms receiver, surge control tank, separator tank, or hot well) associated with hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operation."

40 CFR 1032(c) states "Determinations of vent emissions and emissions reductions or total organic compound concentrations achieved by **add-on control devices** may be based on

[16] Ibid: Section 1.2.2 Feeds for the 2016 Schedule (Reference 3).

[17] Idaho High-Level Waste and Facilities Disposition, Final Environmental Impact Statement, September 2002, DOE/EIS-0287.

engineering calculations or performance tests. If performance tests are used to determine vent emissions, emission reductions, or total organic compound concentrations achieved by add-on control devices, the performance tests must conform with the requirements of ss 264.1034(c).” [emphasis added]

Clearly, both the PEWE and the ETS meet the criteria of operations under the “process vent category in the 40 CFR 264.1031 and 1032(c) due to the specific language of “add-on control devices” that the permit identifies above with the POG and APS units.

The permit claims that only the Liquid Effluent Treatment and Disposal (LET&D) has a “Process vent” for emission release. [18] **Commenter believes that DOE is attempting to obfuscate the RCRA “Process Vent” regulatory requirements of the PEWE and the High-level Waste Evaporator (ETS) and therefore represents a fundamental flaw in the Permit to meet MACT standards.**

As evaporators, the HLLWE, PEWE, and LET&D feed do not meet the RCRA treatment standards specified for the above list of 29 hazardous waste throughput constituents in 40 CFR 268.40. Also of the total 128 hazardous waste evaporator throughput constituents, 86 are hazardous air pollutants listed in 42 USC 7412 list of pollutants covered under the Clean Air Act MACT emission standards that DOE has made no attempt to comply with. Additionally, discharge of the evaporator “overheads” containing these pollutants (even after illegal dilution) to INTEC percolation ponds is prohibited.

Sources of Organics to INTEC Liquid Waste Management System
ILWMS Feed

1. INTEC Spent Nuclear Fuel Reprocessing Raffinate in High-level Tank Farm
2. Analytic Laboratories
3. Radioactive Liquid Waste Management System
   a. a. Annual decontamination of evaporator with oxalic acid
   b. b. Floor and Cell washings (EDTA)
   c. c. NWCF Decontamination Shop and HEPA filter leachate
   d. d. Tank Farm valve box cleanings
   e. e. High-level Waste Tank Heel removal/flushes
4. CPP-666 FAST
   - Spent Nuclear Fuel Pool Water Filter Back-flush Waste
5. CPP-637 Laboratories
   - Trybutyl phosphate
   - Dodecane
   - Crown ethers
   - Octanol
   - Other specialized chemicals
6. Maintenance Services
   - Organic based cleaning solutions
7. HEPA Filter Leachate System Effluent to ILWMS
8. Debris Treatment Effluent to ILWMS

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[18][3] Also see Permit page 11 for definition of “Process Vent” and IDAPA 58.01.05.008 and 40- CFR 264.1031.

DOE's report also erroneously claims that:

* "NESHAP Applicability (40 CFR 61) [section 4.7]. This permitting action does not trigger any new NESHAP requirements."
*"MACT Applicability (40 CFR 63) Section 4.8 This permitting action does not trigger any new MACT requirements."
* "CAM Applicability (40 CFR 64) Section 4.9; This permitting action does not trigger any new CAM requirements.

The *Advanced Off-Gas Control System Design For Radioactive And Mixed Waste Treatment* below offers significant analysis of the treatment issues related to the IWTU.

"THE HWC MACT STANDARDS

"The U.S. Environmental Protection Agency (EPA) has regulated air pollutant emissions from hazardous waste combustors based on maximum achievable control technology (MACT). The full regulation is under National Emission Standards for Hazardous Air Pollutants (NESHAP): Final Standards for Hazardous Air Pollutants for Hazardous Waste Combustors, [U. S. Code of Federal Regulations (CFR), Title 40, Part 63, Subpart EEE (Part 63 Sections 1200 through 1214)], most recently revised July 1, 2004 (EPA 2004a). The Hazardous Waste Combustor (HWC) MACT standards were promulgated in a joint effort of Resource Conservation and Recovery Act (RCRA) and the Clean Air Act (CAA) regulations, intended to consolidate and revise air emission and operational requirements previously regulated by RCRA. [emphasis added]

"The EPA first proposed the HWC MACT standards in April 1996 (EPA 1996). In the years since then, EPA has received many comments, and has revised the proposed standards many times (EPA 1997, EPA 1999, EPA 2002a, EPA 2002b). Both industry and environmental groups litigated against the final standards. Industry groups petitioned that the standards were incorrectly restrictive, based on EPA's emission database; environmental groups petitioned that the standards were not restrictive enough based on the same database. In 2001, the U.S. Court of Appeals ruled that EPA had erred in developing these MACT standards (Bastian 2002) by not appropriately using the emissions database. In response to the court ruling, EPA quickly implemented an Interim Standard Rule (ISR)
(EPA 2002a). The ISR will remain in force until EPA promulgates the Phase I Final Replacement Standards and Phase II. The Phase I Final Replacement Standards and Phase II will include new, revised MACT emission standards, technical amendments not included in the ISR, and Phase II HWC MACT sources (EPA 2004b).

"Existing and new incinerators, cement kilns, lightweight aggregate kilns, solid fuel-fired boilers, liquid fuel-fired boilers, and hydrochloric acid production furnaces, that use hazardous wastes, are regulated differently, with different emission limits for some species, in the Phase I Final Replacement Standards and Phase II standards. For illustration, emission limits of the Defense Waste Processing Facility (DWPF) at SRNL (Norton 2002, Goles 1996)

"Refractory-lined, water- cooled joule-heated melter Film cooler, dilution air, spray quench, off-gas condenser, 2-stage steam atomized scrubber (SAS), condenser, HEME, HEPA, sand filter, induced draft fan.

"Opened 1996. Presently operating. As of 2002, has processed over 20% of a total 140 million liters of stored HLW, reducing over 1,200 stainless steel canisters of borosilicate HLW glass.

"The EPA has included mixed waste thermal treatment facilities among facilities regulated under the HWC MACT standards because of the hazardous waste component of mixed waste. Shortly after the HWC MACT standards were proposed, the U. S. Department of Energy (DOE) Mixed Waste Focus Area provided commented to EPA that it was not appropriate or practical to regulate mixed waste treatment facilities under the HWC MACT standards (Eaton 1996, INEEL 1996, Pelletier 1997), because the radiological hazards of mixed waste, in addition to the chemical and toxic hazards associated with the hazardous waste component, make mixed wastes and mixed waste treatment facilities sufficiently unique to require other regulations than those that focus just on the hazardous waste component. The EPA considered excluding mixed wastes from the HWC MACT standards, but eventually included mixed wastes in the MACT standards promulgation.

"These hazards also dictate strict control of radioactive contamination and exposure to protect workers, the public, and the environment. Regulating mixed waste thermal treatment facilities under the HWC MACT standards has created some distinct challenges for these facilities because the HWC MACT standards are in some cases incompatible with some DOE requirements, especially As Low As Reasonably Possible (ALARA) requirements. Regulating mixed waste treatment under the MACT standards introduces incompatibilities that are not readily resolved and will require negotiation with regulators. For example, the Hanford RPP WTP recently negotiated with EPA to waive the 7% O_2 correction for the joule-heated melters that will be used to treat Hanford's LAW and HLW. These tank wastes are aqueous solutions that contain practically no organic content. During vitrification, they would produce essentially no combustion gas, even though organic reductants added to the melter feed to react with nitrates and nitrites in the feed will produce combustion gas (CO_2 and H_2O). The 7% O_2 correction is not possible when the off-gas, as in the case of Hanford's melters, is primarily purge and cooling air (Oh 2000)." [19]

"NEW MIXED WASTE THERMAL TREATMENT AND OFF-GAS CONTROL SYSTEMS IN THE U.S.

New mixed waste treatment facilities or upgrades of existing facilities have been proposed, or are presently in design and construction, to meet current waste treatment and off-gas control requirements. Examples are listed in Table III.

"Some of these, such as the LLW and HLW melter systems for the Hanford River Protection Project, are under construction. Others, such as the In-Container Vitrification (ICV) melter process for supplemental LAW waste treatment at Hanford, and the fluidized bed steam reformer system at INL, are in design and demonstration phases. Some other systems such as the proposed SBW Vitrification Facility, and the proposed NWCF upgrade for HWC MACT compliance, were conceptually designed, complete with equipment and facility sizing and mass and energy balances, but were eventually not selected for further design and construction.

"These new or proposed mixed waste treatment facilities indicate how specific mixed wastes are being treated to meet storage and disposal requirements and how compliance to the HWC MACT standards is being accomplished for mixed waste treatment facilities. Pre-existing facilities that are continuing operation with HWC MACT compliance are doing so with feed limits or by limited modifications to enable compliance.

"Regardless of primary mixed waste thermal treatment technology, MACT-compliant off-gas systems generally have these unit operations:

* Off-gas temperature adjustment – cooling to filtration/scrubbing temperatures and heating for preventing moisture condensation or for certain offgas reaction processes such as organics oxidation or NOx reduction.
* PM, radionuclide, and condensable metals removal
* Acid gas removal
* NOx control (in cases when the feed contains nitrated compounds)
* Final certified, usually redundant HEPA filtration How these unit operations are used are defined by design and performance objectives that apply at most mixed waste treatment facilities (Peurrung 1996, Oh 2000, Anderson 2003):
* Control off-gas emissions to meet regulatory limits
* Provide continuous process and emissions monitoring
* Ensure that a nuclear criticality will be avoided
* Accept off-gas flowrate and composition variations from the primary treatment process without upsets or degradation of performance beyond acceptable limits
* Operate reliably with minimal downtime and upsets
* Comply with As Low As Reasonably Achievable (ALARA) objectives by minimizing the exposure of workers, the public, and the environment to radiological and other hazards
* Minimize amounts of secondary streams and maximize ease of secondary stream final treatment and disposal
* Minimize total treatment facility life-cycle cost

[19] *Advanced Off-Gas Control System Design For Radioactive And Mixed Waste Treatment*

* Minimize technology implementation risk Specific off-gas technologies, and their sequence in off-gas systems, vary depending on site-specific requirements and designer preferences for meeting the general above-listed objectives. In some cases, discriminators between specific offgas control technologies are minor, and their selection depends more on designer preference or trade-off of lower-tier objectives. For example, some designers favor submerged bed wet scrubbers over other scrubbers (because of this technology's passive scrubbing features), where-as other designers favor high-energy or packed bed scrubbers (that also meet scrubbing objectives, with lower pressure drops, but require active scrub solution pumping)."[pg4]

Table II. Interim and proposed final HWC MACT emission limits.

Pollutant/surrogate (a)	Interim Standard Rule (EPA 2004a)	Proposed Final Replacement Standard (b) (EPA 2004b)
Dioxin/furans, ng TEQ/dscm (c)	0.20	0.11 for dry air pollution control devices (APCDs) or waste heat boilers (WHBs); 0.2 for others
Hg, ug/dscm	45	8
Particulate matter (PM), mg/dscm	34 (0.015 gr/dscf)	1.6 (0.00070 gr/dscf) [or an alternative to this standard (d)]
Semivolatile metals (SVM – Cd and Pb), ug/dscm (e)	120	6.5
Low volatile metals (LVM – As, Be, Cr), ug/dscm, (e)	97	8.9
Total HCl/Cl_2 as HCl, ppm (f)	21	0.18 (or site-specific, risk-based emission limit based on national exposure standards)
Total hydrocarbon (THC) (g, h)	10 (or 100 ppm CO)	Same
Destruction and Removal Efficiency (DRE)	99.99% each POHC (i), 99.9999% for dioxin wastes	Same

a. Some parameters are used as surrogates to indicate compliance with hazardous air pollutants. PM is used as a surrogate for non-enumerated metals Sb, Co, Mn, Ni, and Se. CO and HC are used as surrogates for organic hazardous air pollutants. DRE is used to indicate the control of organic hazardous air pollutants other than D/Fs, which are controlled by a specific standard.
b. All emission concentrations are corrected to a dry, 7% O_2 basis.
c. TEQ = Toxicity equivalency quotient, the international method of relating the toxicity of different dioxin/furan congeners to the toxicity of 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (2,3,7,8-TCDD).
d. The 3-part alternative to the PM standard – (a) meet the SVM and LVM standards for both enumerated and non-enumerated metals not including Hg, (b) demonstrate reasonable metals feed control, and (c) demonstrate that the air pollution control system achieves at least 90% semivolatile metals removal efficiency.
e. Total metals regardless of speciation.
f. Total HCl and Cl_2 in HCl equivalents (Cl_2 in ppm is multiplied times 2 to get HCl equivalents).
g. Hourly rolling average. THC is reported as propane.
h. Facilities that choose to comply with the CO standard by continuously monitoring CO rather than HC emissions must also demonstrate compliance with the HC standard of 10 ppmv during DRE test runs performed in the comprehensive performance test.
i. POHC = Principal organic hazardous constituent.

Table III. Example mixed/radioactive waste treatment and off-gas control systems currently planned, proposed, or under construction in the U.S.

Facility	Treatment system	Off-gas system	Status and comments
Proposed upgrade for the NWCF to meet HWC MACT standards	Fluidized bed calciner, cyclone recycle, 700 L/hr (180 gal/hr) aqueous acidic nitrated SBW	Existing: Cyclone, spray quench, venturi scrubber, separator, condenser, mist eliminator, reheater, packed bed Ru adsorber, mist eliminator, reheater, 3-stage HEPAs, 2-stage compressor, demister, reheater, HEPA Proposed upgrade: HEPA filters, staged NO_x and organics destruction, reheater, carbon bed Hg sorption, reheater, final HEPA and ID fan	Upgrading the existing NWCF to meet HWC MACT compliance has been studied in feasibility studies and preconceptual designs since 1997 (Rawlins 1997, Ashworth 2000, Soelberg 2003a, Barnes 2003, Merrick 2004, Barnes 2004). Upgrading the NWCF to enable continued NWCF operation with MACT compliance was eventually not selected as the preferred SBW treatment option.
Proposed SBW Waste Vitrification Facility at the INL	Refractory-lined joule-heated melter	Film cooler, acid quench, venturi, HEME, reheater, prefilter, HEPA, staged NO_x and organics destruction, quench, ME, reheater, carbon bed Hg sorption, HEPA, ID fan	Vitrifying the SBW was one of several alternatives evaluated for treating the SBW (Quigley 2000, Bates 2001, Taylor 2001, Barnes 2004). The off-gas system was designed to be HWC MACT-compliant (Wood 2001). SBW vitrification was eventually not selected as the preferred SBW treatment option.
Proposed SBW steam reforming facility at the INL	Fluidized bed steam reformer system	Cyclone, oxidizing unit, partial quench, prefilter, HEPAs, carbon bed Hg sorption, ID fan	SBW steam reforming was one of several alternatives evaluated for treating the SBW (Williams 2002, Barnes 2004, Cowan 2005). Steam reforming has been selected as the preferred SBW treatment option.
Hanford River Protection Project (RPP) Waste Treatment Plant (WTP) HLW and LLW joule heated melters	Two separate refractory-lined joule-heated melters – 1 for HLW and 1 for LLW	Film cooler, submerged bed scrubber (SBS), wet electrostatic precipitator (WESP, with recycle back to the melter feed), high efficiency mist eliminator (HEME), (HLW melter system only), heater, 2-stage HEPAs, ID fan, carbon bed Hg sorption, Ag mordenite I sorber (HLW melter system only), gas-gas heat exchanger, heater, thermal catalytic oxidizer (TCO), 2-stage NO_x selective catalytic reduction (SCR), packed bed scrubber (PBS), HEME, ID fan	Design, construction, and permitting in simultaneous progress, scheduled for startup in about 2011 or later. An off-gas system design based on high temperature filtration and staged NO_x/organics destruction was initially recommended (Peurrung 1996) but eventually not selected.
Demonstration Bulk Vitrification System (DBVS) (Hanford LAW supplemental treatment) (Raymond 2005)	~650 kW graphite-electrode joule-heated disposable in-container melter (In-Container Vitrification, ICV); melter box designed to be final glass container	Melter hood, sintered metal high temperature filter, water scrubbing, caustic scrubbing, NO_x SCR with Tri-Mer SBS for backup NOx control, HEPA filtration.	Bulk vitrification was selected over other candidate technologies in 2003. The full-scale demonstration facility, DVBS, startup is planned for late 2005.

"OFF-GAS TECHNOLOGIES AND CONCEPTS FOR FUTURE OFF-GAS SYSTEM DESIGNS

"The INL has been researching, developing, and using a variety of mixed waste treatment and off-gas control technologies and systems for decades. The INL has operated a mixed waste incinerator, a mixed waste metal melter, two fluidized bed calciners, and high level waste and mixed waste evaporators. Each of these treatment systems has included offgas control systems. In the past decade, the INL has tested, developed, and designed advanced treatment technologies including high temperature melters, thermal desorption, and fluidized bed calcination and steam reforming technologies.

"These projects have included off-gas control technology development and demonstrations in the five most challenging areas, or areas of greatest need and technical uncertainty, for mixed waste off-gas control: high temperature filtration, NO_x control, organics oxidation, Hg control, and off-gas system design concepts. A few recommendations can now be made for future mixed waste off-gas system designs based on work at the INL and advances elsewhere that can provide more confidence in certain new off-gas control technologies or new applications.

"High Temperature Filtration

"High temperature filtration has been in use in many applications for decades. Examples of successful high temperature filter operation in radioactive processes include the radioactive waste operations at the Forshungzentrum Karlsruhe (Karlsruhe Research Center) in Germany (Dirks 1998), and the Studsvik

Radioactive Waste Fluidized Bed Steam Reforming Processing Facility in Erwin, Tennessee (Mason 1999). During the late 1990's, the DOE Mixed Waste Focus Area funded high temperature filtration demonstration projects. Most recently, high temperature filtration was included for the past 4 years of periodic demonstration tests performed by the INL for fluidized bed steam reforming (Olson 2004).

"These successful operations and demonstrations of high temperature filtration provide operating data showing that high temperature filtration can be used more widely in mixed waste off-gas systems. Both sintered metal and ceramic filters have been used with success, and each have specific advantages.

"Sintered metal filters, such as were used in the INL steam reforming tests, are less susceptible to physical or thermal shock. Removal efficiencies for the INL filters ranged between 99.5% to over 99.9%. While ceramic filters are susceptible to breakage from physical or thermal shock, these are used successfully in the Studsvik radioactive waste steam reforming facility with removal efficiencies ranging up to 99.9%. The filters are replaced during every shutdown, by allowing the old filters to fall into the filter hopper after which they are broken up and combined with the filter ash product.

"NO_x Control and Organics Oxidation

"Several NO_x control technologies including selective catalytic reduction (SCR), non-selective non-catalytic education (NSNCR), and steam reforming have been studied for mixed waste off-gas systems for many years. SCR NO_x control was successfully demonstrated for the INL New Waste Calcining Facility in the 1990's, was used successfully at the West Valley Demonstration Project, and is planned for the Hanford River Protection Project melter systems. However, concerns about SCR catalyst poisoning, SCR reagent handling, process control during upset conditions, and formation of potentially explosive ammonium nitrate, have limited SCR applications and have increased process cost and complexity.

"The INL has discarded SCR NO_x control in favor of NSNCR, also called staged combustion. Test results and modeling (MSE 2001, Boardman 2004, Olson 2004) have provided data and confidence in the ability of NSNCR to achieve high efficiency NO_x destruction (exceeding 99% under some conditions) and high efficiency destruction (exceeding 99.99% for some conditions) of residual organics in off-gas streams from melters, calciners, and steam reformers. Properly operated NSNCR systems can achieve not only highly efficient destruction of off-gas NO_x resulting from processing nitrate and nitrite-bearing mixed wastes, but also can replace any other offgas organics control technology. This combination eliminates any concerns related to SCR NO_x control and can meet applicable regulatory limits for both NO_x and hydrocarbon emissions and for POHC destruction efficiency.

"NSNCR systems tested to date have used added fossil fuel (natural gas, propane, or fuel oil) to provide heat needed to heat the off-gas to the desired operating temperatures of 800-1,000$_o$C, and to adjust the off-gas stoichiometry in the first (deNO_x) stage. The added stage 1 fuel (and air, if needed) needed to heat the off-gas can cause the total off-gas flowrate to increase by 1.5 to 3 times. This increase can be eliminated by using electrical or indirect heating to heat the off-gas to the stage 1 temperature. A demonstration-scale prototype of an electrically-heated NSNCR process for destroying NO_x and residual hydrocarbons from a liquid-fed cold crucible induction
melter (CCIM) is shown in Figure 1.

"Mercury Control

"Mercury was used in fuel reprocessing, and so is present in liquid mixed wastes from nuclear fuel reprocessing activities.

"Mercury control efficiencies exceeding 99.9% are required for thermally treating these wastes compliant to the HWC MACT standards. The INL has been studying and developing technologies to remove Hg from the liquid wastes, and to remove Hg from mixed waste treatment off-gas, for over a decade (Chambers 1998, Soelberg 2003b). Results show that (a) even if waste pretreatment is used to remove much of the Hg prior to thermal treatment, efficient off-gas Hg control will still be necessary for Hg-laden fuel reprocessing wastes, and (b) the only reliable and efficient technology presently available for Hg control in mixed waste off-gas systems is sulfurimpregnated [sic]activated carbon beds. Wet scrubbing, used in some non-nuclear applications, is not reliable enough or efficient enough for removing off-gas Hg regardless of speciation. Innovations such as oxidizing systems to oxidize elemental Hg to less volatile or more water-soluble species, that would enable more efficient and reliable Hg wet scrubbing, are promising, but not sufficiently demonstrated for mixed waste [pg6] processes. Carbon injection, used worldwide for Hg and dioxin/furan control, is not generally efficient enough, and it generally produces up to 10 times more spent carbon waste than fixed carbon beds do. [emphasis added]

"Laboratory and pilot-scale tests have shown that sulfurimpregnated carbon can sorb Hg, regardless of speciation, with high efficiencies (up to at least 99.97%) and low outlet Hg concentrations (down to below

1 ug/dscm, corrected to 7% O_2, dry basis) (Boardman 2004, Olson 2004, and others). These test results and design projects have determined full-scale carbon bed design and operating parameters (Soelberg 2003).

"Innovative Off-gas System Design Concepts

"Using the off-gas technologies described above, mixed waste off-gas systems can be configured that might be simpler, more reliable, have lower technical risk, and have lower costs than some current designs. For example, the off-gas system for the Hanford River Protection Project LAW melter has up to 13 different unit operations, not counting the second HEPA and the second SCR bed (Figure 2). Part of this complexity is because the hot melter gas is cooled for wet scrubbing, then reheated for filtration, then heated some more for hydrocarbon oxidation and SCR NO_x destruction (and probably cooled between the two SCR stages), and cooled again for more wet scrubbing. All these unit operations cause enough pressure drop that either two ID fans are required at different locations, or a portion of the off-gas system downstream of the first ID fan will need to operate at positive pressure, not desired for contamination control in mixed waste processes.

"A simpler off-gas system (Figure 2)uses NSNCR NO_x and hydrocarbon control removes PM and radionuclides early in the process, and utilizes only 9 different unit operations (counting the 2-stage NSNCR reactor as 2 unit operations), while avoiding issues including (a) nitration and acidification of the SBS and WESP solutions, (b) the above-listed NO_x SCR issues, (c) catalyst poisoning and destruction efficiency issues for the thermal catalytic oxidizer (TCO), and (d) carbon bed performance questions related to its placement upstream of the TCO and SCR, where elevated NO_x and hydrocarbon concentrations might interfere with Hg sorption. This configuration is similar to the Option 2 recommended for the Hanford LLW vitrification process off-gas system in 1996 (Peurrung 1996).

"The off-gas flowrate will increase for the recommended system configuration by 1-2x due to the additions of NO_x reductant, oxidizing air, and evaporated water.

"This increase is dwarfed in the 13-step design by a 5-10x increase caused by the film cooler air, water spray quenches, and NO_x reductant addition. Some uncertainty in this new concept exists, especially regarding slagging and corrosion control in the NSNCR reactor. This might be controlled by allowing slagging and using appropriate equipment design and material selection. An even simpler alternative places the carbon bed after the 2-stage HEPA, eliminating the need for the reheater, and eliminating the potential for Hg contamination of the scrub solution. More quantitative comparisons of these different system configurations, obtained by performing equipment and footprint sizing, mass and energy balances, and cost estimates for each configuration, might confirm that the recommended options have lower costs and lower technical risk.

"CONCLUSIONS AND RECOMMENDATIONS

"Air emission regulations have become increasingly stringent in recent years. New mixed waste treatment facilities in the U. S. are being designed to operate in compliance with recently promulgated HWC MACT standards. Specific off-gas technologies, and their sequence in off-gas systems, vary depending on site-specific requirements and designer preferences for meeting the general above-listed objectives.

"Activities have been underway for the past 10 years to identify, develop, demonstrate, and design technologies for enabling MACT compliance for mixed waste treatment facilities. Some specific off-gas control technologies and system designs have been identified and tested to show that even the stringent MACT standards can be met, while minimizing treatment facility size and cost.

"Successful operations and demonstrations of high temperature filtration have provided operating data that shows that high temperature filtration can be used more widely in mixed waste off-gas systems. A range of specified removal efficiencies are available. Removal efficiencies of 99.5% to over 99.9% have been demonstrated.

"Test results and modeling over several years provide performance data and confidence in the ability of NSNCR to achieve high efficiency NO_x destruction (exceeding 99% under some conditions) and also high efficiency destruction (exceeding 99.99% for some conditions) of residual organics in off-gas streams from melters, calciners, and steam reformers.

"Using electrical or indirect heating to heat the off-gas to the stage 1 temperature can reduce the total off-gas flowrate. Mercury is ubiquitous in liquid mixed wastes from nuclear fuel reprocessing activities. Mercury control efficiencies exceeding 99.9% are required for thermally treating these wastes compliant to the HWC MACT standards. Fixed beds of sulfur-impregnated activated carbon are still the best technology presently available for achieving this level of Hg control in mixed waste off-gas systems.

"Using the off-gas technologies described above, some innovative mixed waste off-gas systems can be configured that are simpler, and might be more reliable, have lower technical risk, and lower costs than some current designs." [20] [emphasis added]

Defense Nuclear Facility Safety Board report to Congress

"**Integrated Waste Treatment Unit**. During 2012, the Board's staff evaluated preparations to commence operations of the Integrated Waste Treatment Unit project at Idaho National Laboratory. This facility is designed to convert approximately 900,000 gallons of radioactive liquid waste stored in tanks at the Idaho Nuclear Technology and Engineering Center to a solid form in preparation for permanent disposal. On June 16, 2012, the process system over-pressurized during pre-operational testing using nonradioactive materials. The system's off-gas filters were breached, creating an unimpeded path from the process vessels to the environment. The staff reviewed the operating contractor's corrective action plan and found several weaknesses. Among the staff's concerns was the potential for improper operation of bypass valves in the pressure relief system to impact the function of safety-significant rupture disks that protect other portions of the process system from over-pressurizing. The staff's communication of this concern prompted the contractor to declare a Potential Inadequacy of the Safety Analysis to ensure the issue was formally tracked and resolved. The Board continues to monitor the project's progress as DOE prepares to resume startup activities." [21]

Defense Nuclear Facility Safety Board Review [22]

"In June 2012, while facility workers were executing Test Instruction-102, *IWTU Integrated System Test: Hot Start-up*, IWTU experienced an over-pressurization event that forced a prolonged shutdown of the facility. During this shutdown, project personnel developed and implemented a Corrective Action Plan (CAP) in response to the over-pressurization event.

"After the completion of the actions required by the CAP, CWI conducted a Contractor Readiness Assessment (CRA) beginning in January 2014. Due to equipment faults and preparation deficiencies, CWI personnel were not able to achieve operational conditions at IWTU during the CRA, and it was suspended before all review objectives could be fulfilled. The CRA resumed on March 3, 2014, after normal operating temperatures and pressures had been achieved in a portion of the facility's systems, and without the introduction of steam or non-radioactive waste simulant. The CRA team concluded its review on March 7, 2014, without fully satisfying the CRA Implementation Plan (IP) criterion to have achieved full operating temperature.

"The DOE Readiness Assessment (RA) team commenced its review at IWTU on March 1, 2014. Members of the Board's staff were on-site to observe the DOE RA team conduct the first three days of its assessment.

"Staff Observations of DOE RA. The staff review team made the following observations during the DOE RA. The review team shared these observations with DOE Idaho Operations Office (DOE-ID) personnel, including the DOE-ID Manager.

"Facility Operating Status—The staff members noted that IWTU's off-gas system was not operating at the beginning of the DOE RA and had not been brought up to operating temperature. IWTU's greatest hazards to facility and collocated workers are controlled by the off-gas system, and it includes the majority of safety-significant controls in the facility. As a result of the June 2012 over-pressurization event, project personnel implemented many design modifications to the off-gas system. The modified components had not yet been tested under their normal operating temperature, pressure, and flow conditions. Therefore, the effects of these design modifications on operating parameters throughout the rest of the IWTU plant, including on safety systems, were unknown. The staff team believes that without this information, it is not possible to make a defensible conclusion that the facility can proceed safely with nuclear waste processing operations.

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[20] Advanced Off-Gas Control System Design For Radioactive And Mixed Waste Treatment, INL/CON-05-00658 PREPRINT.

[21] http://www.dnfsb.gov/sites/default/files/Board%20Activities/Reports/Reports%20to%20Congress/2013/ar_2013228_21831_0.pdf

[22] Defense Nuclear Facility Board, May 23, 2014 letter to Honorable Ernest J. Moniz, Secretary of Energy, from Peter S. Winokur, Ph.D., Chairman.

"Considering the non-operational status of the off-gas system, the staff members believed that the IWTU facility was not in an appropriate condition to adequately conduct the full independent assessment that an RA is expected to provide. Specifically, the requirements of the DOE RA's Plan of Action (POA) and IP could not be met in this plant configuration, as the majority of safety-credited systems were not operating, and several recent design modifications could not be tested. The POA states, "The DOE Readiness Assessment will be conducted with the plant at full operating temperature under test procedure TI-102, once CWI provides a readiness to proceed memorandum to the Department." DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*, requires RAs to be conducted in strict accordance with their POAs and IPs. Therefore, the staff team considered IWTU's declaration of readiness to be premature and that the facility had not demonstrated its readiness to safely restart operations.

"The staff review team discussed its observations with DOE-ID and DOE RA team personnel. The DOE RA team leader subsequently requested that CWI commence the off-gas system heat-up during the DOE RA. CWI's managers agreed to this request. This evolution required the resolution of 21 specific engineering actions, from procedural changes to calculating new process operating parameters. Similar additional engineering actions are required before IWTU can introduce steam, and eventually waste simulant, into the process system, which is necessary to complete DOE-ID's IWTU startup plan. While conducting the off-gas system heat- up, a Technical Safety Requirement (TSR) violation occurred due to a safety-significant system in the off-gas system not being properly configured for operation. Operators entered a Limiting Condition for Operations and shifted the facility to its warm standby mode. In the DOE RA team's out-brief to facility personnel, the RA team leader noted the resolution of this situation as a pre-start issue.

"DOE RA Scope—DOE Order 425.1D requires the scope of the RA to "be based, in part, on the status of and changes to the facility." The POA for the DOE RA lists 24 specific facility modifications to be reviewed, but notes that the list is not all-inclusive. The IP contains the same list of modifications in its scope, but omits the "not all-inclusive" caveat. When the staff members discussed this inconsistency with the DOE RA team leader, he indicated that the DOE RA team did not have the resources to perform a review of every facility modification. The staff review team believes that a review of all facility modifications is needed to comply with the
intent of DOE Order 425.1D, particularly for such a first-of-a-kind facility startup.

"DOE RA Scheduling—The POA for the DOE RA included an approximate two-week break between the CRA and the DOE RA. However, prior to the March 2014 restart of the CRA, DOE-ID managers made the decision to commence the DOE RA approximately 48 hours after the approval of the CRA team's final report. The extent of the corrective actions that would be required by the CRA's pre-start findings was unknown at the time the decision was made to move up the start date of the DOE RA. The DOE RA team's final report included a post-start finding that concluded that DOE-ID is not holding IWTU to the requirements of DOE Order 425.1D, that the DOE RA was not in compliance with the approved POA, and that acceleration of the schedule between the CRA and DOE RA led to compromises regarding compliance with DOE's readiness process. The Board's staff review team believes that the decision to reduce the time between the CRA and the DOE RA negatively impacted the ability of the RA to fulfill the need for an independent assessment of facility operations.

"DOE Lessons Learned Summary on IWTU. On March 13, 2014, DOE's Office of Health, Safety and Security (HSS) published Operating Experience Summary Issue Number 2014-01, Article 1: *Lessons Learned from Inadequacies in Management and Oversight at the IWTU*. Regarding IWTU's 2012 ORRs, the HSS summary notes that, "Startup of first-of-a-kind facilities such as IWTU requires a phased approach to ensure that personnel adequately understand the attributes of each component singly and within an integrated system. The selected demonstrations for the ORRs did not provide a representative spectrum of the activities necessary to safely startup the facility as described in the Startup Plan."

" The staff review team believes that the completion of an integrated startup testing program, prior to declaring readiness, would ensure that the operators and equipment at a first-of-a-kind facility are capable of demonstrating all activities necessary to safely startup the facility during its readiness reviews. Such a program was not completed before the DOE RA at IWTU.

"The HSS summary also emphasized the need to establish expectations for normal and abnormal process conditions and to "require rigorous assurance that equipment and personnel will function as credited in the approved safety basis documentation" during startup of a first-of- a-kind facility like IWTU. The staff review team believes that this rigorous assurance is best provided by independent technical assessments that ensure safety system performance under expected operating parameters.

"**Issues Identified During IWTU Startup Testing.** Since the completion of the DOE RA in March 2014, CWI personnel have identified several issues during startup testing. These issues appear to require significant engineering efforts to resolve and may result in changes to the IWTU safety basis and design. The magnitude of the engineering and operational changes may be significant enough to warrant independent review prior to the start of nuclear operations. Examples of some of these issues are described below. DOE-ID and CWI personnel expect to identify additional issues as startup testing continues.

"Granular Activated Carbon (GAC) Bed Potential Inadequacy of the Safety Analysis (PISA)—On April 3, 2014, during a subsequent attempt at off-gas system heat-up, CWI declared a PISA at IWTU with respect to the estimated time to GAC vessel failure when subjected to the maximum credible fire temperature of 1000 °C. The GAC vessels are a significant portion of the off-gas system and have several safety-significant controls to ensure their proper operation. Engineers discovered that the GAC vessel wall thickness used in the original engineering analysis of a fire in the vessel did not take into account the corrosion rate of the vessel wall. Following the declaration of this PISA, a test hold was put in place with the process off-gas bypassing the GAC vessels. CWI is performing an analysis of the GAC vessels with the anticipated wall corrosion rate. Following the conclusion of the analysis, CWI engineers will determine if changes are required to IWTU's safety basis and/or operating procedures.

"High Off-Gas Temperature Causes Actuation of Safety Instrumented Function (SIF)-2 Panel—On April 11, 2014, while heating up the GAC beds, IWTU experienced a SIF-2 trip due to high temperature in the process off-gas system. The SIF-2 safety instrumented system performs a safety-significant function to prevent a release of hazardous concentrations of nitrous oxide and mercury resulting from a breach in the off-gas system due to high off-gas temperatures. To assist in the heat-up of the GAC beds, the Shift Supervisor directed the Control Room Operator (CRO) to increase the outlet temperature of the Off-Gas Cooler (OGC). The CRO made the associated adjustment to the OGC's automatic temperature controller. After approximately 30 minutes, the CRO shifted the OGC's temperature control from automatic to manual to aid in maintaining the desired outlet temperature. Soon after, the test engineer noted that the OGC and GAC bed outlet temperatures were rising more rapidly than previously observed. Consequently, the Assistant CRO (ACRO), who had responsibility for maintaining the OGC outlet temperature, attempted to lower the OGC temperature. In doing so, the ACRO adjusted the temperature controller in the wrong direction, reducing the amount of cooling provided by the OGC. The OGC outlet temperature subsequently rose to 204 °C, causing the SIF-2 trip, which prevented further heat-up of the GAC beds.

"Inadequate Operation of Hydrogen Analyzer System—On April 18, 2014, while reviewing the hydrogen analyzer in preparation for adding steam to IWTU's processing systems, CWI engineers noted that a gas sampling line was unexpectedly cold. Gas samples are drawn from the Process Gas Filter (PGF), routed through the hydrogen analyzer, and returned to the Denitration Mineralization Reformer. An eductor [sic][sic]provides the motive force to move the sampled gas. The engineers directed a series of troubleshooting actions to determine if obstructions existed in the sample lines or the educator [sic], but found none. The engineers believe that the design of the educator [sic] is inadequate to draw the required sample from the PGF. They are re-evaluating the eductor's [sic] design and intend to procure a replacement. Management personnel made the decision to shut down and cool down the facility until corrective actions can be implemented. This situation highlights the consequences of the numerous unknowns associated with how the as-built IWTU facility operates.

"**Staff Conclusion.** The staff review team believes that the scope and depth of the engineering actions required to address the TSR violation, PISA, design changes, and transitions to steam and non-radioactive simulant feeds indicate a lack of assurance that the facility can safely proceed with nuclear operations. These changes may result in a safety basis, facility design, and operational procedures very different from those assessed during the DOE RA. DOE Order 425.1D requires a readiness review after substantial process, system, or facility modifications. Additional and independent technical assessments, such as an additional readiness review, may be necessary to ensure that all potential safety and operational issues have been identified and appropriately resolved prior to introducing radioactive feed." [23]

Subsequently, a month later, DOE's Acting Assistant Secretary for Environmental Management sent the DNFSB *Report on the Evaluation of the Need for Additional*

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[23] Defense Nuclear Facility Board, May 23, 2014 letter to Honorable Ernest J. Moniz, Secretary of Energy, from Peter S. Winokur, Ph.D., Chairman.

Independent Assessment of Startup Readiness for the Integrated Waste Treatment Unit. "DOE agrees that IWTU will benefit from an additional independent assessment at the completion of startup testing and prior to the introduction of radioactive waste feed as described in the enclosed report." [24]

The DNFSB review is not comprehensive enough to be anything but a high-level overview. However, it remains the only "independent" analysis available to the public. Certainly it cannot be called extensive. And IWTU is too unique of a facility for much of the DNFSB's expertise to rapidly hone in on any problems not previously identified. Their quick look at IWTU may be of some reassurance to the DOE regulators who must approve hot startup, but as with most audits, it is of limited scope and cannot be considered comprehensive. And it may even promote a false sense of security.

Occurrence Reports

DOE's Occurrence Reports document serious malfunctions of the IWTU that state:

"On Saturday, June 16, 2012, the Integrated Waste Treatment Unit (IWTU) was performing startup and testing activities when an unexpected pressure transient caused a loss of vacuum in the Carbon Reduction Reformer (CRR) vessel activating the Rapid Shutdown System (RSS).

"IWTU Operations were in the process of performing the system lineup to transfer Off-Gas Filter (OGF) material to the Product Receiver Filter/Product Receiver Cooler-1 (PRF/PRC-1) when the CRR began losing vacuum needed to maintain established operating parameters and to continue heat-up of the steam reforming process. Control room operators backed out of the product transfer lineup, exited the transfer procedure and continued to operate the plant under the IWTU startup procedure.

" IWTU Operations personnel, with engineering support, continued to monitor the system and make adjustments throughout the evening attempting to restore CRR heat up and to maintain vacuum. During the adjustments, the pressure in the CRR rose to approximately 14 inches of water column. The RSS trip point is 14.0 inches of water column. Downstream temperature and differential pressure problems became evident in the HEPA filters, 260 and 240 blower systems. A pressure increase in the Off-Gas Cooler (OGC) caused a rupture of the rupture disk on the OGC and an increase in the OGC outlet temperature which tripped Safety Instrumented Function (SIF)-2. The failure of the rupture disk and the tripping of SIF-2 are the initiating events for this ORPS occurrence. Timeline: 11:57 - A Hi CRR pressure alarm was received. Operators responded per procedure by raising the Off-Gas Blower speed. CRR pressure responded as expected and pressure returned to normal. 12:08 CRR pressure began to rise. Operators responded per procedure and pressure became erratic. 12:20 - CRR pressure began to rapidly rise passing through the Hi and Hi-Hi alarm set-points. 12:24 - A Hi-Hi-Hi CRR pressure alarm was received along with the corresponding Distributed Control System (DCS) - RSS activation. 13:05 - The shift supervisor commenced plant shutdown per procedure. During shutdown a dark plume was noted coming from the stack. 13:35 - The OGC rupture disc pressure alarm was received indicating Rupture Disc PSE-SRC-160-003, a design feature SSC, had ruptured. 13:59 - Following rising temperatures at the outlet of the OGC, SIF-

[24] David Huizenga, DOE Acting Assistant Secretary for Environmental Management letter to Peter S. Winokur, Chairman Defense Nuclear Safety Board, June 20, 2014.

2 High-Temperature Protection System (a Safety Significant System) activated.

"Immediate Action(s): All applicable Emergency Action Response procedure steps were verified completed and a plant shutdown/cool-down was initiated. Notifications were made to DOE-ID and CWI Corporate." [25]

An on-site employee at INTEC during the IWTU startup "incident;" states the "he was not sure whether or not that there had actually been an explosion (of coal dust) but it's pretty darn certain that ALL of the IWTU's off-gas filters had failed resulting in 'stuff' being blown up the stack. These filters include the sintered ceramic blow back filters at the tops of the cyclones situated downstream of both the fluidized bed reactors (DMR & CRR) and the main bank of HEPA filters situated immediately upstream of the main stack." [26]

"On March 13, 2012, a Hot Work Permit was authorized and a Fire Safety Watch was present for workers to weld and grind brackets in Room 109 South Corridor at IWTU. At 1430 hours MST, the Fire Safety Watch observed smoke coming out of the fume extractor unit, disconnected the unit and took it outside of the facility. After taking the smoking unit outside the Fire Safety Watch removed the spark trap cover and observed a small flame in the pre-filter which self-extinguished.

"The workers were performing hot work (welding and grinding) installing supports on an electrical cable tray. The workers were in compliance with the hot work permit. Due to the restricted work area the intake funnel on the fume extractor hose was located below the hot work area, pointed up and positioned close to the welding location, but not directly under. The cable tray is approximately 10 feet above the ground with the fume extractor, ACE Industrial Products, Model No 73-200 M, located on a cart below. It appears that a hot spark was sucked into the funnel and down the hose into the spark trap portion of the fume extractor. The spark was drawn onto the surface of the pre-filter where it caused the pre-filter media to smolder generating the smoke observed by the fire watch." [27]

"Waste Treatment: Startup testing was suspended on June 16, 2012, at the Integrated Waste Treatment Unit (IWTU), which is designed to treat about 900,000 gallons of liquid radioactive waste stored at the Idaho Nuclear Technology and Engineering Center. Testing was suspended and plant heat-up was terminated to allow detailed evaluation of the process temperature, pressure and flow excursion observed on June 16. Facility startup testing has been ongoing for the past month, evaluating system and component operation and response during operating conditions. Radioactive waste has not been introduced into the facility, pending successful completion of startup testing." [28]

"July 17, 2012: A potential inadequate safety analysis was declared as part of the investigation into the pressure event that occurred during start-up of the Integrated Waste Treatment Facility. It was determined that the potential for "blinding" filter systems in the facility with unburned charcoal had not been adequately analyzed in the current safety documents. The facility was shut down after the June 16 pressure event, and an investigative

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[25] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0008

[26] Darryl Siemer 6/22/12 email to Chuck Broscious

[27] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0004

[28] DOE-ID Operations Summary; For the Period June 5 to June 18, 2012.

team was commissioned to determine the root causes of the event and how to correct them." [29]

"Waste Treatment Progress: Progress continues in the effort to resume start-up activities for the Integrated Waste Treatment Unit, after the "pressure event" halted start-up activities last summer. **The IWTU** is designed to treat the remaining 900,000 gallons of liquid waste stored at the Idaho Nuclear Technology and Engineering Center tank farm. With the completion of the IWTU main process piping flush, the project can now start reassembling the process gas filter, off gas filter and the carbon reduction reformer. Restart activities are anticipated to resume this summer. [30] [emphasis added]

"Dec. 17, 2013: An investigation was initiated into the adequacy of controls for relief valves and a rupture disk at the Integrated Waste Treatment Unit (IWTU). If the valves are not properly controlled, pressure could increase downstream of the rupture disks during process heat-up. This increase could cause a condition where the rupture disks would not rupture at the required pressure to protect the process off-gas system. IWTU operations have been shut down and will not resume until the necessary changes have been made to the facility or procedures)." [31]

"June 19, 2012: Operators at the Integrated Waste Treatment Unit were performing start-up testing when an unexpected pressure transient caused a loss of vacuum in the Carbon Reduction Reformer vessel, activating the Rapid Shutdown System. All applicable emergency action procedures were followed, and a plant shutdown was initiated. A team has been formed to evaluate the cause of the incident and recommend corrective actions.)." [32]

"July 17, 2012: A potential inadequate safety analysis was declared as part of the investigation into the pressure event that occurred during start-up of the Integrated Waste Treatment Facility. It was determined that the potential for "blinding" filter systems in the facility with unburned charcoal had not been adequately analyzed in the current safety documents. The facility was shut down after the June 16 pressure event, and an investigative team was commissioned to determine the root causes of the event and how to correct them.)." [33]

U.S. Nuclear Waste Technical Review Board

"The NWTRB is an independent agency of the U.S. Federal Government. Its sole purpose is to provide independent scientific and technical oversight of the Department of Energy's program for managing and disposing of high-level radioactive waste and spent nuclear fuel." [34]

According to Dr. Darryl Siemer, former INL scientist, "the people on the NWTRB Board are supposed to serve as totally independent advisors/counselors to DOE on its "technical' issues - kinda like what the folks at the National Academy of Sciences & Defense Nuclear Facility

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[29] DOE Occurrence Report, EM-ID—CWI-IWTU-2012-0009

[30] DOE-ID Operations Summary -13 4-1; For the Period Feb. 12 to Feb. 25, 2013.

[31] DOE-ID Operations Summary 13.01; For the Period Dec. 11, 2012-Jan. 2, 2013, citing DOE Occurrence Report EM-ID—CWI-IWTU-2012-0013.

[32] DOE-ID Operations Summary; For the Period June 19 to July 12, 2012, citing EM-ID—CWI-IWTU-2012-0008.

[33] DOE-ID Operations Summary; For the Period July 13 to Aug. 2, 2012, (EM-ID—CWI-IWTU-2012-0009

[34] http://NWTRB.gov

Safety Board are also supposed to be doing for it (us?). Frankly, I think that DOE has made captives of all of its "advisors" because 1) it's both fun & lucrative (about $165K/yr. for part time work) to be one of DOE's pet independent experts, and 2) they don't really have to do all much for it (their support staff does all the scut work). The main problem is that DOE usually dictates what its independent experts are supposed to "think" about & provides them with carefully rehearsed dog & pony shows/selected documents to "bring them up to speed" on each such issue. Most of these experts don't seem to question what they're being told & therefore usually end up not spotting/fixing the real problem(s)."

Respectfully Submitted

Chuck Broscious
President

References in Addition to Footnotes:

1. HWMA/RCRA Part A Application for INEEL Volume 1 Book 1 (EPA form 8700-23), January 2000, DOE/ID-10213.
2. Carlson Memo TLC-07-94 page 6; DOE/ID-10544, October 1996; HLLWE waste codes D001 (Ignitable) and D002 (Corrosive) require deactivation in see 40 CFR 268.40.
3. DOE/ID-1544, October 1996, pages 14 to 17 for listing of Tank Farm Waste codes, and 42 USC 7412 list of Hazardous Air Pollutants.

Figures 5.2.3 through 5.2.14 indicate that groundwater plumes having the largest surface area and contaminated pore water volumes are located at INEL and Hanford. The two INEL contaminated groundwater sites are large contaminant plumes within the Snake River Plain Aquifer. One of these plumes is associated with operations at the Test Area North (TAN), while the other is associated with operations at the Idaho Chemical Processing Plant (ICPP) and the Test Reactor Area (TRA). Both contaminant plumes were caused by multiple sources, including injection wells and percolation ponds.

7/30/12; ITWU – Failure to Follow Confined Space Entry Process; [35]
5/2/12; ITWU Potential Inadequacy of Safety Analysis (PISA) – Inadequacy of Technical Safety Requirements TSR-level Controls for Fire Detection in Granular Activated Carbon Beds; [36]
4/25/12; ITWU Hazardous Energy Control Process Violation; [37]
2/27/12; IWTU – Safety Significant Pressure Safety Disk PSE- SRH-141-001A Discovered Ruptured; [38]

[35] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0011
[36] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0007
[37] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0006
[38] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0002

Annual Report-1990/Environmental Monitoring for EG8'cG Idaho Facilities at INEL EGG-2612(90)

Chemical Constituents in the Dissolved and Suspended Fractions of Ground Water from Selected Sites, INEL and Vicinity, Idaho, 1989/US Geological Survey, Open-File Report 92-51 DOE/ID-22101

Tritium Concentrations in Flow from Selected Springs that Discharge to the Snake River, Twin Falls-Hagerman Area, Idaho/U.S. Geological Survey Water-Resources Investigations Report 894156 DOE/ID-22084

Iodine-129 in the Snake River Plain Aquifer at INEIJU.S. Geological Survey/Water-Resources Investigation Report 884165 DOE/ID-22076

Compilation and Summarization of the Subsurface Disposal Area Radionuclide Transport Data at the EGG-ER-10546

INEL Solid Waste Estimates Calculations includes Addendum of 283: Estimation of Constituent Inventories for the Subsurface Disposal Area (SDA) in the Radioactive Waste Management Complex)

Interim-Action Risk Assessment for the Test Reactor Area (TRA) Warm-Waste Leach Pond Sediments (OU-2-10)/informal Report (excerpts) EGG-WM-9622

A Brief Analysis and Description of Transuranic Wastes in the Subsurface Disposal Area of the Radioactive Waste Management Complex at INEIJRev I (also assigned [1]1052)(5 pp.) EGG-WTD-9438

Compilation and Summarization of the Subsurface Disposal Area Radionuclide Transport Data at the EGG-ER-10546

Final Work Plan for the Organic Contamination in the Vadose Zone Operable Unit 7-08 Focused Remedial Investigation/Feasibility Study/Rev I EGG-WM-10049

Radionuclides, Chemical Constituents, &Organic Compounds in Water from Designated Wells &Springs from the Southern Boundary of INEL to the Hagerman Area, ID, 1989/U.S. Geologic Survey/Open Rpt 91-232 DOE/ID-22098

Hydrologic Conditions and Distribution of Selected Chemical Constituents in Water, Snake River Plain Aquifer, INEL, 1986-1988/U.S. Geology's Survey/Water-Resources Investigations Report 914047 DOE/ID-22096

Phase I/Remedial Investigation/Feasibility Study, Work Plan and Addendum for the Warm Waste Pond Operable Unit at the Test Reactor Area of INEL/Draft/Vol. 2/Rev 3 EGG-WM-8814

Phase I/Remedial Investigation/Feasibility Study, Work Plan and Addendum for the Warm Waste Pond Operable Unit at the Test Reactor Area of INEL/Draft/Vol. I/Rev 3 EGG-WM-8814

Radioactive Waste Management Complex Trench 27 Mercury Investigation/Informal Report EGG-WM-9730

Track 2 Summary Report for Operable Unit 2-11 at the Test Reactor Area/Draft/Rev 0 EGG-ERD-10518

Scoping Investigation Sampling and Analysis Plan Field Sampling Plan for Pad A of the Radioactive Waste Management Complex at INEL/Rev 0 (excerpts) EGG-WM-9626

Summary of RWMC Investigations Report/Revision 0 EGG-WM-9708

Radioactive Waste Management Complex Investigations Report/Vol. I of 5/Rev 0 EGG-WM-9707

Remedial Investigation/Feasibility Study Work Plan for the Subsurface Disposal Area, Radioactive Waste Management Complex at INEL/Draft EGG-WM-8776

Environmental Defense Institute

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September 2014

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RE: Preliminary Comments on U.S. Department of Energy Renewal of the Mixed Hazardous Waste Permit for the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Laboratory, Permit Number EPA ID No. ID4890008952 Liquid Waste Management System and the Integrated Waste Treatment Unit. IDEQ Public Notice of Intent 8/18/14, Docket Number 10HW-1402.

Idaho Department of Environmental Quality (IDEQ) issued a public notice 8/18/14 proposing to issue a Renewal Partial Permit for Hazardous Waste Storage and Treatment for the Idaho Nuclear Technology Center (INTEC) Liquid Waste Management System (ILWMS).

The Department of Energy (DOE) Idaho National Laboratory (INL) currently has an approved HWMA/RCRA Storage and Treatment Partial permit for Liquid Waste Management System (LWMS). This permit is due to expire on October 18, 2014. CH2M-WG Idaho, LLC is the current operating contractor for ILMS.

These comments for the public record are submitted by the Environmental Defense Institute (EDI) Inc. We reserve the right to submit supplemental comments due to limited time (45 days) allowed for comments.

EDI's 8/13/13 "Comments on Department of Energy (DOE) Idaho National Laboratory (INL) Highly Radioactive Sodium Bearing Waste Tank Closure Program and Integrated Waste Treatment Unit (IWTU) and Replacement Capacity for Disposal of Remote Handled Low-level Waste," are referenced because the various operations are fundamentally interconnected and the issues articulated were never resolved. [1]

[1] Environmental Defense Institute Comments on DOE's LWMS, Highly Radioactive Sodium Bearing Waste Tank Closure Program and Integrated Waste Treatment Unit (IWTU) and Replacement Capacity for Disposal of Remote

Section I: Summary

EDI finds the "new" Volume 14 LWMS permit reapplication slightly better than the original permit but still deficient. Due to the limited comment time (45 days) and huge volume of Permit Volume 14 (~1,389 pages), EDI's comments will be incomplete. [2] This has been correctly called a "paper dump" that no individual or NGO could possibly adequately review in 45 days.

Additionally, the 45-day comment period (ending 8/2/14) provided by IDEQ is inadequate given the importance of this major new operation (Integrated Waste Treatment Unit) IWTU, the failed applied treatment technology and the potential for significant environmental impact. Therefore, EDI requests that the comment period be extended to 120 days.

The DOE Permit Request submitted to IDEQ includes a new previously classified high-level radioactive and hazardous waste processing plant. This is the deadliest material on the planet short of nerve- gas and therefore deserves more public consideration than IDEQ is providing.

"The LWMS is composed of numerous permitted accumulation tanks, ancillary piping and four primary treatment units including:

* "The process Equipment Waste Evaporator (PEWE) a closed loop evaporator system with the condensed overheads and still bottoms held for further treatment.
* "The Liquid Effluent Treatment and Disposal unit employs fractionation columns to treat the PEWE overheads, recovering a nitric acid stream that is reused.
* "The Evaporator Treatment System, located in CPP-659 further concentrates higher activity liquid wastes.
* "The integrated Waste Treatment Unit (IWTU) is a new steam reformer system built to convert the remaining sodium bearing tank farm waste into a solid form. The IWTU includes dry solids and indoor waste pile storage associated with managing the treated waste." [3]

Integrated Waste Treatment Unit (IWTU)

The INL Integrated Waste Treatment Unit (IWTU) is designed to convert ~900,000 gallons of previously classified high-level liquid waste generated over decades of nuclear fuel reprocessing together with newly generated waste to a solid form suitable for final disposal in a geologic repository. It is crucial to remember that this is the most deadly material on the planet. A dixy cup of it on the table in front of you would give you a fatal dose of radiation before you could get up and leave the room.

DOE has been trying for decades to convert this liquid waste into a stable form that can be put into a permanent waste repository. This more recent DOE treatment – IWTU - from construction to startup has taken over 7 years.

EDI conducted an assessment of relevant DOE and other agency reports related to the IWTU, and offer them below. The documented evidence below will give a reasonable person pause before endorsing DOE's choice of radioactive waste treatment technology and the State of Idaho's ability to oversee the operation.

Handled Low-level, August 13, 2013, available on EDI website.

[2] HWMA/RCRA Part B Permit Reapplication for the Idaho National Laboratory, Volume 14- Idaho Nuclear Technology and Engineering Center Liquid Waste Management System (ILWMS), EPA ID No. ID4890008925, April 2014, Book 1 (342 pgs.) 2 (437 pgs.), 3 (177 pgs.) ,and 4 (433 pgs.).

[3] Public Notice: Intent to Renew Permit, Idaho Department of Environmental Quality, 8/18/14.

Defense Nuclear Facility Safety Board report to Congress

"**Integrated Waste Treatment Unit**. During 2012, the Board's staff evaluated preparations to commence operations of the Integrated Waste Treatment Unit project at Idaho National Laboratory. This facility is designed to convert approximately 900,000 gallons of radioactive liquid waste stored in tanks at the Idaho Nuclear Technology and Engineering Center to a solid form in preparation for permanent disposal. On June 16, 2012, the process system over-pressurized during pre-operational testing using nonradioactive materials. The system's off-gas filters were breached, creating an unimpeded path from the process vessels to the environment. The staff reviewed the operating contractor's corrective action plan and found several weaknesses. Among the staff's concerns was the potential for improper operation of bypass valves in the pressure relief system to impact the function of safety-significant rupture disks that protect other portions of the process system from over-pressurizing. The staff's communication of this concern prompted the contractor to declare a Potential Inadequacy of the Safety Analysis to ensure the issue was formally tracked and resolved. The Board continues to monitor the project's progress as DOE prepares to resume startup activities." [4]

Defense Nuclear Facility Safety Board Review [5]

"In June 2012, while facility workers were executing Test Instruction-102, *IWTU Integrated System Test: Hot Start-up*, IWTU experienced an over-pressurization event that forced a prolonged shutdown of the facility. During this shutdown, project personnel developed and implemented a Corrective Action Plan (CAP) in response to the over-pressurization event. After the completion of the actions required by the CAP, CWI conducted a Contractor Readiness Assessment (CRA) beginning in January 2014. Due to equipment faults and preparation deficiencies, CWI personnel were not able to achieve operational conditions at IWTU during the CRA, and it was suspended before all review objectives could be fulfilled. The CRA resumed on March 3, 2014, after normal operating temperatures and pressures had been achieved in a portion of the facility's systems, and without the introduction of steam or non-radioactive waste simulant. The CRA team concluded its review on March 7, 2014, without fully satisfying the CRA Implementation Plan (IP) criterion to have achieved full operating temperature.

"The DOE Readiness Assessment (RA) team commenced its review at IWTU on March 1, 2014. Members of the Board's staff were on-site to observe the DOE RA team conduct the first three days of its assessment.

"Staff Observations of DOE RA. The staff review team made the following observations during the DOE RA. The review team shared these observations with DOE Idaho Operations Office (DOE-ID) personnel, including the DOE-ID Manager.

"Facility Operating Status—The staff members noted that IWTU's off-gas system was not operating at the beginning of the DOE RA and had not been brought up to operating temperature. IWTU's greatest hazards to facility and collocated workers are controlled by the off-gas system, and it includes the majority of safety-significant controls in the facility. As a result of the June 2012 over-pressurization event, project personnel implemented many design modifications to the off-gas system. The modified components had not yet been tested under their normal operating

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[4] http://www.dnfsb.gov/sites/default/files/Board%20Activities/Reports/__Reports%20to%20Congress/2013/ar_2013228_21831_0.pdf

[5] Defense Nuclear Facility Board, May 23, 2014 letter to Honorable Ernest J. Moniz, Secretary of Energy, from Peter S. Winokur, Ph.D., Chairman.

temperature, pressure, and flow conditions. Therefore, the effects of these design modifications on operating parameters throughout the rest of the IWTU plant, including on safety systems, were unknown. The staff team believes that without this information, it is not possible to make a defensible conclusion that the facility can proceed safely with nuclear waste processing operations.

"Considering the non-operational status of the off-gas system, the staff members believed that the IWTU facility was not in an appropriate condition to adequately conduct the full independent assessment that an RA is expected to provide. Specifically, the requirements of the DOE RA's Plan of Action (POA) and IP could not be met in this plant configuration, as the majority of safety-credited systems were not operating, and several recent design modifications could not be tested. The POA states, "The DOE Readiness Assessment will be conducted with the plant at full operating temperature under test procedure TI-102, once CWI provides a readiness to proceed memorandum to the Department." DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*, requires RAs to be conducted in strict accordance with their POAs and IPs. Therefore, the staff team considered IWTU's declaration of readiness to be premature and that the facility had not demonstrated its readiness to safely restart operations.

"The staff review team discussed its observations with DOE-ID and DOE RA team personnel. The DOE RA team leader subsequently requested that CWI commence the off-gas system heat-up during the DOE RA. CWI's managers agreed to this request. This evolution required the resolution of 21 specific engineering actions, from procedural changes to calculating new process operating parameters. Similar additional engineering actions are required before IWTU can introduce steam, and eventually waste simulant, into the process system, which is necessary to complete DOE-ID's IWTU startup plan. While conducting the off-gas system heat- up, a Technical Safety Requirement (TSR) violation occurred due to a safety-significant system in the off-gas system not being properly configured for operation. Operators entered a Limiting Condition for Operations and shifted the facility to its warm standby mode. In the DOE RA team's out-brief to facility personnel, the RA team leader noted the resolution of this situation as a pre-start issue.

"DOE RA Scope—DOE Order 425.1D requires the scope of the RA to "be based, in part, on the status of and changes to the facility." The POA for the DOE RA lists 24 specific facility modifications to be reviewed, but notes that the list is not all-inclusive. The IP contains the same list of modifications in its scope, but omits the "not all-inclusive" caveat. When the staff members discussed this inconsistency with the DOE RA team leader, he indicated that the DOE RA team did not have the resources to perform a review of every facility modification. The staff review team believes that a review of all facility modifications is needed to comply with the intent of DOE Order 425.1D, particularly for such a first-of-a-kind facility startup.

*"DOE RA Scheduling—*The POA for the DOE RA included an approximate two-week break between the CRA and the DOE RA. However, prior to the March 2014 restart of the CRA, DOE-ID managers made the decision to commence the DOE RA approximately 48 hours after the approval of the CRA team's final report. The extent of the corrective actions that would be required by the CRA's pre-start findings was unknown at the time the decision was made to move up the start date of the DOE RA. The DOE RA team's final report included a post-start finding that concluded that DOE-ID is not holding IWTU to the requirements of DOE Order 425.1D, that the DOE RA was not in compliance with the approved POA, and that acceleration of the schedule between the CRA and DOE RA led to compromises regarding compliance with DOE's readiness process. The Board's staff review team believes that the decision to reduce the time between the CRA and the DOE RA negatively impacted the ability of the RA to fulfill the need for an independent assessment of facility operations.

"DOE Lessons Learned Summary on IWTU. On March 13, 2014, DOE's Office of

Health, Safety and Security (HSS) published Operating Experience Summary Issue Number 2014-01, Article 1: *Lessons Learned from Inadequacies in Management and Oversight at the IWTU*. Regarding IWTU's 2012 ORRs, the HSS summary notes that, "Startup of first-of-a-kind facilities such as IWTU requires a phased approach to ensure that personnel adequately understand the attributes of each component singly and within an integrated system. The selected demonstrations for the ORRs did not provide a representative spectrum of the activities necessary to safely startup the facility as described in the Startup Plan." The staff review team believes that the completion of an integrated startup testing program, prior to declaring readiness, would ensure that the operators and equipment at a first-of-a-kind facility are capable of demonstrating all activities necessary to safely startup the facility during its readiness reviews. Such a program was not completed before the DOE RA at IWTU.

"The HSS summary also emphasized the need to establish expectations for normal and abnormal process conditions and to "require rigorous assurance that equipment and personnel will function as credited in the approved safety basis documentation" during startup of a first-of-a-kind facility like IWTU. The staff review team believes that this rigorous assurance is best provided by independent technical assessments that ensure safety system performance under expected operating parameters.

"Issues Identified During IWTU Startup Testing. Since the completion of the DOE RA in March 2014, CWI personnel have identified several issues during startup testing. These issues appear to require significant engineering efforts to resolve and may result in changes to the IWTU safety basis and design. The magnitude of the engineering and operational changes may be significant enough to warrant independent review prior to the start of nuclear operations. Examples of some of these issues are described below. DOE-ID and CWI personnel expect to identify additional issues as startup testing continues.

"Granular Activated Carbon (GAC) Bed Potential Inadequacy of the Safety Analysis (PISA)—On April 3, 2014, during a subsequent attempt at off-gas system heat-up, CWI declared a PISA at IWTU with respect to the estimated time to GAC vessel failure when subjected to the maximum credible fire temperature of 1000 °C. The GAC vessels are a significant portion of the off-gas system and have several safety-significant controls to ensure their proper operation. Engineers discovered that the GAC vessel wall thickness used in the original engineering analysis of a fire in the vessel did not take into account the corrosion rate of the vessel wall. Following the declaration of this PISA, a test hold was put in place with the process off-gas bypassing the GAC vessels. CWI is performing an analysis of the GAC vessels with the anticipated wall corrosion rate. Following the conclusion of the analysis, CWI engineers will determine if changes are required to IWTU's safety basis and/or operating procedures.

"High Off-Gas Temperature Causes Actuation of Safety Instrumented Function (SIF)-2 Panel—On April 11, 2014, while heating up the GAC beds, IWTU experienced a SIF-2 trip due to high temperature in the process off-gas system. The SIF-2 safety instrumented system performs a safety-significant function to prevent a release of hazardous concentrations of nitrous oxide and mercury resulting from a breach in the off-gas system due to high off-gas temperatures. To assist in the heat-up of the GAC beds, the Shift Supervisor directed the Control Room Operator (CRO) to increase the outlet temperature of the Off-Gas Cooler (OGC). The CRO made the associated adjustment to the OGC's automatic temperature controller. After approximately 30 minutes, the CRO shifted the OGC's temperature control from automatic to manual to aid in maintaining the desired outlet temperature. Soon after, the test engineer noted that the OGC and GAC bed outlet temperatures were rising more rapidly than previously observed. Consequently, the Assistant CRO (ACRO), who had responsibility for maintaining the OGC outlet temperature, attempted to lower the OGC temperature. In doing so, the ACRO

adjusted the temperature controller in the wrong direction, reducing the amount of cooling provided by the OGC. The OGC outlet temperature subsequently rose to 204 °C, causing the SIF-2 trip, which prevented further heat-up of the GAC beds.

"Inadequate Operation of Hydrogen Analyzer System—On April 18, 2014, while reviewing the hydrogen analyzer in preparation for adding steam to IWTU's processing systems, CWI engineers noted that a gas sampling line was unexpectedly cold. Gas samples are drawn from the Process Gas Filter (PGF), routed through the hydrogen analyzer, and returned to the Denitration Mineralization Reformer. An eductor [sic]provides the motive force to move the sampled gas. The engineers directed a series of troubleshooting actions to determine if obstructions existed in the sample lines or the educator [sic], but found none. The engineers believe that the design of the educator [sic] is inadequate to draw the required sample from the PGF. They are re-evaluating the eductor's [sic] design and intend to procure a replacement. Management personnel made the decision to shut down and cool down the facility until corrective actions can be implemented. This situation highlights the consequences of the numerous unknowns associated with how the as-built IWTU facility operates.

"Staff Conclusion. The staff review team believes that the scope and depth of the engineering actions required to address the TSR violation, PISA, design changes, and transitions to steam and non-radioactive simulant feeds indicate a lack of assurance that the facility can safely proceed with nuclear operations. These changes may result in a safety basis, facility design, and operational procedures very different from those assessed during the DOE RA. DOE Order 425.1D requires a readiness review after substantial process, system, or facility modifications. Additional and independent technical assessments, such as an additional readiness review, may be necessary to ensure that all potential safety and operational issues have been identified and appropriately resolved prior to introducing radioactive feed." [6]

Subsequently, a month later, DOE's Acting Assistant Secretary for Environmental Management sent the DNFSB *Report on the Evaluation of the Need for Additional Independent Assessment of Startup Readiness for the Integrated Waste Treatment Unit*. "DOE agrees that IWTU will benefit from an additional independent assessment at the completion of startup testing and prior to the introduction of radioactive waste feed as described in the enclosed report." [7]

The DNFSB review is not comprehensive enough to be anything but a high level overview. However, it remains the only "independent" analysis available to the public. Certainly it cannot be called extensive. And IWTU is too unique of a facility for much of the DNFSB's expertise to rapidly hone in on any problems not previously identified. Their quick look at IWTU may be of some reassurance to the DOE regulators who must approve hot startup, but as with most audits, it is of limited scope and cannot be considered comprehensive. And it may even promote a false sense of security.

Occurrence Reports

DOE's Occurrence Reports document serious malfunctions of the IWTU that state:

"On Saturday, June 16, 2012, the Integrated Waste Treatment Unit (IWTU) was performing startup and testing activities when an unexpected pressure transient caused a loss of vacuum in the

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[6] Defense Nuclear Facility Board, May 23, 2014 letter to Honorable Ernest J. Moniz, Secretary of Energy, from Peter S. Winokur, Ph.D., Chairman.

[7] David Huizenga, DOE Acting Assistant Secretary for Environmental Management letter to Peter S. Winokur, Chairman Defense Nuclear Safety Board, June 20, 2014.

Carbon Reduction Reformer (CRR) vessel activating the Rapid Shutdown System (RSS).

"IWTU Operations were in the process of performing the system lineup to transfer Off-Gas Filter (OGF) material to the Product Receiver Filter/Product Receiver Cooler-1 (PRF/PRC-1) when the CRR began losing vacuum needed to maintain established operating parameters and to continue heat-up of the steam reforming process. Control room operators backed out of the product transfer lineup, exited the transfer procedure and continued to operate the plant under the IWTU startup procedure.

" IWTU Operations personnel, with engineering support, continued to monitor the system and make adjustments throughout the evening attempting to restore CRR heat up and to maintain vacuum. During the adjustments, the pressure in the CRR rose to approximately 14 inches of water column. The RSS trip point is 14.0 inches of water column. Downstream temperature and differential pressure problems became evident in the HEPA filters, 260 and 240 blower systems. A pressure increase in the Off-Gas Cooler (OGC) caused a rupture of the rupture disk on the OGC and an increase in the OGC outlet temperature which tripped Safety Instrumented Function (SIF)-2. The failure of the rupture disk and the tripping of SIF-2 are the initiating events for this ORPS occurrence. Timeline: 11:57 - A Hi CRR pressure alarm was received. Operators responded per procedure by raising the Off-Gas Blower speed. CRR pressure responded as expected and pressure returned to normal. 12:08 CRR pressure began to rise. Operators responded per procedure and pressure became erratic. 12:20 - CRR pressure began to rapidly rise passing through the Hi and Hi-Hi alarm set-points. 12:24 - A Hi-Hi-Hi CRR pressure alarm was received along with the corresponding Distributed Control System (DCS) - RSS activation. 13:05 - The shift supervisor commenced plant shutdown per procedure. During shutdown a dark plume was noted coming from the stack. 13:35 - The OGC rupture disc pressure alarm was received indicating Rupture Disc PSE-SRC-160-003, a design feature SSC, had ruptured. 13:59 - Following rising temperatures at the outlet of the OGC, SIF-2 High-Temperature Protection System (a Safety Significant System) activated.

"Immediate Action(s): All applicable Emergency Action Response procedure steps were verified completed and a plant shutdown/cool-down was initiated. Notifications were made to DOE-ID and CWI Corporate." [8]

An on-site employee at INTEC during the IWTU startup "incident;" states the "he was not sure whether or not that there had actually been an explosion (of coal dust) but its pretty darn certain that ALL of the IWTU's off-gas filters had failed resulting in 'stuff' being blown up the stack. These filters include the sintered ceramic blow back filters at the tops of the cyclones situated downstream of both the fluidized bed reactors (DMR & CRR) and the main bank of HEPA filters situated immediately upstream of the main stack." [9]

"On March 13, 2012, a Hot Work Permit was authorized and a Fire Safety Watch was present for workers to weld and grind brackets in Room 109 South Corridor at IWTU. At 1430 hours MST, the Fire Safety Watch observed smoke coming out of the fume extractor unit, disconnected the unit and took it outside of the facility. After taking the smoking unit outside the Fire Safety Watch removed the spark trap cover and observed a small flame in the pre-filter which self-extinguished.

"The workers were performing hot work (welding and grinding) installing supports on an electrical cable tray. The workers were in compliance with the hot work permit. Due to the restricted work area the intake funnel on the fume extractor hose was located below the hot work

[8] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0008

[9] Darryl Siemer 6/22/12 email to Chuck Broscious

area, pointed up and positioned close to the welding location, but not directly under. The cable tray is approximately 10 feet above the ground with the fume extractor, ACE Industrial Products, Model No 73-200 M, located on a cart below. It appears that a hot spark was sucked into the funnel and down the hose into the spark trap portion of the fume extractor. The spark was drawn onto the surface of the pre-filter where it caused the pre-filter media to smolder generating the smoke observed by the fire watch." [10]

"Waste Treatment: Startup testing was suspended on June 16, 2012, at the Integrated Waste Treatment Unit (IWTU), which is designed to treat about 900,000 gallons of liquid radioactive waste stored at the Idaho Nuclear Technology and Engineering Center. Testing was suspended and plant heat-up was terminated to allow detailed evaluation of the process temperature, pressure and flow excursion observed on June 16. Facility startup testing has been ongoing for the past month, evaluating system and component operation and response during operating conditions. Radioactive waste has not been introduced into the facility, pending successful completion of startup testing." [11]

"July 17, 2012: A potential inadequate safety analysis was declared as part of the investigation into the pressure event that occurred during start-up of the Integrated Waste Treatment Facility. It was determined that the potential for "blinding" filter systems in the facility with unburned charcoal had not been adequately analyzed in the current safety documents. The facility was shut down after the June 16 pressure event, and an investigative team was commissioned to determine the root causes of the event and how to correct them." [12]

"Waste Treatment Progress: Progress continues in the effort to resume start-up activities for the Integrated Waste Treatment Unit, after the "pressure event" halted start-up activities last summer. **The IWTU** is designed to treat the remaining 900,000 gallons of liquid waste stored at the Idaho Nuclear Technology and Engineering Center tank farm. With the completion of the IWTU main process piping flush, the project can now start reassembling the process gas filter, off gas filter and the carbon reduction reformer. Restart activities are anticipated to resume this summer. [13]

"Dec. 17, 2013: An investigation was initiated into the adequacy of controls for relief valves and a rupture disk at the Integrated Waste Treatment Unit (IWTU). If the valves are not properly controlled, pressure could increase downstream of the rupture disks during process heat-up. This increase could cause a condition where the rupture disks would not rupture at the required pressure to protect the process off-gas system. IWTU operations have been shut down and will not resume until the necessary changes have been made to the facility or procedures)." [14]

"June 19, 2012: Operators at the Integrated Waste Treatment Unit were performing start-up testing when an unexpected pressure transient caused a loss of vacuum in the Carbon Reduction Reformer vessel, activating the Rapid Shutdown System. All applicable emergency action

[10] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0004

[11] DOE-ID Operations Summary; For the Period June 5 to June 18, 2012.

[12] DOE Occurrence Report, EM-ID—CWI-IWTU-2012-0009

[13] DOE-ID Operations Summary -13 4-1; For the Period Feb. 12 to Feb. 25, 2013.

[14] DOE-ID Operations Summary 13.01; For the Period Dec. 11, 2012-Jan. 2, 2013, citing DOE Occurrence Report EM-ID—CWI-IWTU-2012-0013.

procedures were followed, and a plant shutdown was initiated. A team has been formed to evaluate the cause of the incident and recommend corrective actions.).”[15]

“July 17, 2012: A potential inadequate safety analysis was declared as part of the investigation into the pressure event that occurred during start-up of the Integrated Waste Treatment Facility. It was determined that the potential for “blinding” filter systems in the facility with unburned charcoal had not been adequately analyzed in the current safety documents. The facility was shut down after the June 16 pressure event, and an investigative team was commissioned to determine the root causes of the event and how to correct them.).”[16]

U.S. Nuclear Waste Technical Review Board

“The NWTRB is an independent agency of the U.S. Federal Government. Its sole purpose is to provide independent scientific and technical oversight of the Department of Energy's program for managing and disposing of high-level radioactive waste and spent nuclear fuel.”[17]

According to Dr. Darryl Siemer, former INL scientist, “the people on the NWTRB Board are supposed to serve as totally independent advisors/counselors to DOE on its "technical' issues - kinda like what the folks at the National Academy of Sciences & Defense Nuclear Facility Safety Board are also supposed to be doing for it (us?). Frankly, I think that DOE has made captives of all of its "advisors" because 1) it's both fun & lucrative (about $165K/yr for part time work) to be one of DOE's pet independent experts, and 2) they don't really have to do all much for it (their support staff does all the scut work). The main problem is that DOE usually dictates what its independent experts are supposed to "think" about & provides them with carefully rehearsed dog & pony shows/selected documents to "bring them up to speed" on each such issue. Most of these experts don't seem to question what they're being told & therefore usually end up not spotting/fixing the real problem(s).”

Additional Occurrence Reports on IWTU Problems

7/30/12; ITWU – Failure to Follow Confined Space Entry Process;[18]
5/2/12; ITWU Potential Inadequacy of Safety Analysis (PISA) – Inadequacy of Technical Safety Requirements TSR-level Controls for Fire Detection in Granular Activated Carbon Beds;[19]
4/25/12; ITWU Hazardous Energy Control Process Violation;[20]
2/27/12; IWTU – Safety Significant Pressure Safety Disk PSE- SRH-141-001A Discovered Ruptured;[21]

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[15] DOE-ID Operations Summary; For the Period June 19 to July 12, 2012, citing EM-ID—CWI-IWTU-2012-0008.

[16] DOE-ID Operations Summary; For the Period July 13 to Aug. 2, 2012, (EM-ID—CWI-IWTU-2012-0009

[17] http://NWTRB.gov
[18] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0011
[19] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0007
[20] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0006
[21] DOE Occurrence Report; EM-ID-CWI-IWTU-2012-0002

Respectfully Submitted

Chuck Broscious
President

Attachments: EDI ILWMS Sections I –to- V
EDI ILWMS Tank 18 List