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September 1, 2009

Mr. Stephen Loosli
Citizens for a Clean Idaho, Inc.
Via E-mail

RE: Professional Comments Based on the Review of "*The Hematite Project Waste Safety Assessment*", Submitted by Westinghouse Electric Company, LLC, as an Enclosure to HEM-09-52, on May 21, 2009

Dear Mr. Loosli,

You recently contacted me to review the above noted "Hematite Project Waste Safety Assessment" in my capacity as a consulting hydrologist. As you are aware I had no foreknowledge of the Hematite Project prior to you contacting me nor am I predisposed to one position or another with respect to the long-term storage of hazardous waste, recognizing that the safe storage of hazardous waste is a nationwide necessity. You asked me to review the document and provide my impressions on whether the document was satisfactorily thorough and defensible with respect to the discussion of site hydrology and secure long-term storage of the waste.

As detailed below I found some issues with the applicant's discussion of the hydrologic conditions and risks associated with the project. While the study author's are clearly professional and knowledgeable the lack of incisive discussion relating to what are frankly some highly unusual site conditions is concerning. In total, the applicant has documented site conditions that I believe requires a great deal more careful review than you have asked of me and certainly by any agency reviewing this application. I have highlighted areas that I found to be most pressing with respect to the long-term safe-storage of hazardous materials at the site.

> Issue #1. The applicant demonstrates that there is a direct hydrologic connection between Castle Creek and all the underlying aquifers at Site B which is typically the

opposite conclusion one hopes to arrive at with regard to hazardous waste storage sites.

The applicant indicates that the underlying stratigraphy at Site B is complex and therefore difficult to ascertain isolation between the Upper and Lower aquifers, the shallow alluvial aquifer of Castle Creek and the deeper artesian aquifer. However, their own well monitoring data and report statements indicate that there is communication between Castle Creek and the Upper Aquifer, and further, that this communication affects hydraulic head in the Lower Aquifer. In addition to the documented connectivity between Castle Creek and the shallow aquifers, they have also documented a connection between Castle Creek and the artesian aquifer as they state that Castle Creek is in part supported by artesian discharge. They have therefore established a direct hydrologic connection between all of the aquifers underlying Site B and a surface discharging stream 1 mile from the site that is a tributary to the Snake River. In an ideal waste storage facility the applicant is required to demonstrate no connectivity to local surface water; the opposite is presented in this application.

Issue #2. The applicants study indicates that the local hydraulic head associated with the underlying artesian aquifer is significant and geologically impressive while simultaneously documenting through site well data that the area groundwater table is rising. In ideal storage siting, the applicant typically wants to demonstrate a very deep below ground, static and or receding groundwater table; they have documented the opposite condition.

The applicant has demonstrated a groundwater-to-surface water connectivity in the area via Castle Creek and that this connectivity is not in a steady state and in fact indicates a rapidly rising groundwater table beneath Site B. The rise is projected to place the water table at the base of the silo within several decades. Given storage of waste has occurred in the silos, there is no possibility that regulatory agencies would have allowed hazardous material disposal in the silos if trend was known at the time. Given the applicants explicit documentation of a strong upward hydraulic trend of both the deep artesian aquifer and the shallower Upper and Lower Aquifers this creates a scientifically high level of uncertainty with respect to future groundwater elevations at the site. The applicant proposes no hypothesis on the reason for this rise or project an end to the groundwater rise trend. One can therefore plausibly ask the question as to whether the groundwater rise will eventually reach the land surface.

Issue #3. The applicants analysis largely considers the risk of downward contaminant leakage to the underlying Upper and Lower Aquifers which are connected to Castle Creek. However, given the documented groundwater rise the more likely pathway for contaminants leaving the site are through dispersal in a saturated near-surface water table which also includes significant lateral contaminant movement.

Unless the applicants can use scientific evidence or theory to suggest otherwise the principal hydrologic concern with the site is that it could convert to a saturated shallow groundwater area or even surface water discharging area supported by significant upward movement of water under pressure. Based on the documented stratigraphy of the site, if water under pressure accesses the high porosity Bruneau gravels its subsurface flow paths would likely radiate out horizontally through 360 degrees of the compass along any number of fine sand,

silt and thin clay seams. Finally, given the documented artesian head pressure, (measured at 165 feet above ground surface), the head pressure in the Lower Aquifer and apparent communication between that and the overlying, unconfined Upper Aquifer, it cannot be discounted that geologic forces such as an earthquake could take place that resulted in a surface discharge at the site (artesian aquifer expressing on the surface due to a conduit to the surface).

> Issue #4. The applicants data and analysis suggests a highly unusual and dynamic relationship between surface ground pressure at Site B and the underlying aquifers such that simple excavation of trenches and stockpiling overburden on the site dramatically and rapidly alters the elevation of the underlying groundwater.

Data inclusive of that gained from well L-38 suggest hugely significant changes in the underlying groundwater elevation, (up to 10 feet of vertical change), that occurred through simple operational excavation activities that under less complex hydrogeologic conditions would result in no detectable changes in underlying groundwater elevations. This suggests the underlying aquifer dynamics are exceptionally complicated and far from stable or static under the applicant's normal site operating plans, much less insitu. The fact that simple ground pressure from excavated material can drive subsurface water gradients is geologically unusual; the applicants are suggesting that surface ground pressure is communicating with a water table over 100 feet bgs through fluvial and alluvial gravels, sands and silts demands further investigation and explanation. Given the documentation showing connectivity to the Upper and Lower Aquifers and Castle Creek, (and through it to the Snake River), this information has to be reconciled with contaminant dispersal models and fate and transport studies that are assuming far less unique hydrogeologic conditions.

> Issue # 5. The applicant clearly states that well log data analysis from UP-28 and U-29 indicate anomalies in expected poteniometric surfaces based on other well data onsite, and that these anomalies can be explained by upward leakage from the Lower Aquifer to the Upper Aquifer.

This observation, combined with Issues #1-4 above, further confirm that the underlying geohydrology is not well understood and the applicants are collecting some data that is not consistent regarding important aquifer conditions. It further points to a strong likelihood that the Upper and Lower Aquifers are hydrologically communicating to a greater extent than is documented. This is especially concerning given the applicant has documented "moderate upwards hydraulic pressure" in the Lower Aquifer and their confounding findings from well data from UP-28 and UP-29 that "suggests a natural cause for the elevated heads that cannot be explained by the existing data." Unfortunately, there is no reference to what this "natural cause" might be and how it is actually influencing actual findings versus predicted findings.

> Issue #6. Based on the applicant's acknowledgement of complex site stratigraphy, communication between the Upper, Lower, Artesian and Castle Creek shallow alluvial aquifer, and that time trends on this data show rapidly changing conditions, discussions concerning groundwater flux and velocity can be considered no more than speculative exercises.

An appropriately sited hazardous waste disposal facility must demonstrate that future escape of contaminants from the storage site to surrounding groundwater tables and transport off site are not scientifically plausible. However, the applicant completely discounts their own data indicating a high degree of hydrogeologic complexity, and therefore significant uncertainty that has to be attached to outputs from groundwater flux and velocity modeling exercises. The applicant's own data suggests in fact there is a high degree of plausible scientific uncertainty related to groundwater transport modeling. A very clear example of this stated uncertainty is found in the discussion of vertical flux or leakage calculations between the Upper and Lower Aquifer utilizing the principle of Darcy's Law. While their calculation of flux was in fact significant, the applicant discounts their own calculation because it was not supported by their assumptions regarding the differences in water chemistry profiles between the Upper and Lower Aquifers. An equally plausible conclusion is that the Darcy flux equations are accurate and that the understanding of communication between the aquifers, and mixing of different sources and ages of water in the complex underground watertable results in anomolus water chemistry conditions.

> Issue #7. The applicant clearly states a significant trend in groundwater rise beneath the site that is not related to any measurable change in the contributing areas precipitation or surface distribution of water related to agriculture or water storage facilities. Therefore, the observed rise in water table has to be related to a change in conditions in the overall hydrogeographic watershed.

The applicants document a steeply upward hydraulic gradient from the deep underlying artesian aquifer and rising groundwater tables. An explanation for this observation is that the super-regional artesianal aquifer is in a state of change resulting in upwards leakage of water. To dramatically affect the amount of upwards leakage of water from a deep artesianal source either subterranean pressures have been increased and/or new geologic pathways have formed allowing water under pressure to rise. An obvious natural phenomenon capable of altering both pressure and pathways simultaneously is an earthquake. While the applicant's analysis of site stratigraphy does not indicate local shearing reflective of a local earthquake epicenter or area of geologic influence, the applicants have failed to consider the possibility of local effects induced by an earthquake or other geologic events within the greater Snake River Plain artesian aquifer.

Further, the applicant does not consider the risks to the storage site or assumed hydrogeologic conditions based on an analysis of the geologic likelihood of a local earthquake epicenter or the possible ramifications for the stored hazardous waste. The artesian aquifer in the region is geologically unique, vast, interconnected and poorly understood on even local levels. It appears appropriate for the applicant to discuss the relationship of local observed changes in groundwater rise in context to scenarios where artesian aquifer pressures suddenly increase.

In summary, based on my review of the project document I cannot conclude that the applicant has satisfactorily addressed some important hydrogeologic issues. While I understand the site geology is complicated, the central issue revolves around the fact it sits atop a highly pressurized deep artesian aquifer that at least through Castle Creek is communicating with the shallower aquifers beneath the site. The connectivity to Castle Creek and therefore the Snake River is reason enough to subject the applicants findings to closer scrutiny, however, the fact

that the site is experiencing an unexplained and significant rise in groundwater suggests larger hydrogeologic forces are at work that are not satisfactorily explained in the document. The long-term disposal of hazardous waste requires site reviews and investigations of appropriateness well above those typically considered in a development project, and in this case there are some obvious areas that demand further explanation or investigation.

Please don't hesitate to give me a call if you have additional questions. Thank you for engaging my services.

Sincerely,

Scott Gillilan, Principal