

**Meeting Minutes for Hydrogen Safety Interest Group Embedded Meeting  
(During Accident Analysis Subgroup Meeting)**

**2014 EFCOG Safety Analysis Working Group Workshop**

**October 11-16, 2014, Pleasanton, CA**

**Date: Monday, October 13, 2014**

**Accident Analysis Subgroup Meeting, 8:00 AM – 11:00 AM**

The Hydrogen Safety Interest Group (H2SIG) met on Monday, October 13, 2014 as part of the Accident Analysis Subgroup meeting during the EFCOG Safety Analysis Workshop in Pleasanton, California.<sup>1</sup> The meeting agenda is shown in Table 1, and the meeting attendance roster given in Attachment 1. Four participated by telephone, including Mark Johnson (LLNL) and Joe Jones, Jose Velez, and Gary Gault (Oak Ridge TWPC, WAI). Kevin provided meeting information for attendees through presentation slides (Attachment 2).

The agenda was introduced [Slide 2]. General notes were covered concerning the H2SIG EFCOG website, databases, and reports. Links to the DOE Hydrogen Program, the DOE Incidents Database, and the website to the International Association for Hydrogen Safety are identified [Slide 3].

**Table 1. Agenda for H2SIG Portion of AA Subgroup Meeting**

Topic#	Time	Topic	Facilitator
1.	10:00 AM PDT	a. Hydrogen and combustible gas safety notes b. Status of Ongoing White Papers and Reports <ul style="list-style-type: none"> <li>• LFL in Caustic Environments</li> <li>• Hydrogen/Tritium Paper</li> <li>• Panel Session Summary from PSA 2013 Topical Meeting on Nonreactor Facility Use of Probabilistic Risk Analysis (PRA)</li> </ul>	Kevin O’Kula
2.	10:15 AM PDT	6M/2R Container Deflagration/Detonation Analysis Update	Karen Balo (via email correspondence) UCOR; Joe Jones, Gary Gault and Jose Velez (via telecon) WAI
3.	10:40 AM PDT	Supplemental Hydrogen Production	Jackie East (via email correspondence) BWCS Nuclear Safety Manager, DUF6/Paducah
4.	10:55 AM PDT	New Business & Plans for Next Dialogue	All

<sup>1</sup> Earlier this year, a realignment of EFCOG working and interest groups was performed, and as a result, H2SIG is now part of the Accident Analysis Subgroup.

Next, an upcoming American Nuclear Society (ANS) Winter Meeting panel session was previewed. The session on “Hydrogen and Combustible Gas Issues in Nuclear Safety” was organized and chaired by O’Kula, and is set for Tuesday, November 11, 2014 [Slide 4]. The interest in doing this panel in an ANS meeting was to involve others from the commercial nuclear safety and chemical safety community ask for their input. The panel introduces the topic in the Program, saying that in the DOE Complex, nuclear waste is contained, transported, processed, and stored. The age, composition, phase(s), and other characteristics of these constituent waste forms have widely varying distributions, and there can be appreciable degrees of uncertainty especially in older waste streams and configurations. A key concern in these situations is the potential for energetic events involving hydrogen and other combustible gases. This panel discussion will cover hydrogen and combustible gas issues and their impact to nuclear facility safety in the DOE Complex. Topics to be explored are research and development programs for facilities in design as well as operating facilities, database development and uncertainties, deterministic and probabilistic methods, lessons learned from events, regulatory needs, standards development, and recommendations for future work. Perspectives from other industries are of interest, such as oil and gas, chemical processing, and the commercial nuclear sector (e.g., containment hydrogen under low likelihood, severe accident conditions). Panelists are scheduled to be Michael V. Frank (Hanford Waste Treatment Plant), Richard (Chip) H. Lagdon, Jr. (CNS, DOE), Professor Joe Shepherd (Caltech), and J. Kelly Thomas (BakerRisk).

A third note highlighted an April 2016 Tritium Conference in Charleston, SC on the safety, management and handling, science and technology of tritium [Slide 5]. This conference normally features from 25% to 30% of its papers on some aspect of tritium safety or its environmental effects.

The status of three reports was then covered:

1. LFL in Caustic Environments – A report from the Hydrogen Working Party (Sellafield Sites) has been contributed that suggests some mitigation could be provided in some instances by maintaining a caustic environment [Slides 7]. However, at best the approach would not appear to be applicable in a safety context because of uncertainties in storage environments (two notes from Professor Shepherd) [Slide 8]. H2SIG is documenting this discussion as an informal note.
2. Hydrogen/Tritium ARF/RF Paper – A white paper from Terry Foppe (DOE consultant) and Sellafield contributors will be revised to provide information on tritium airborne release fractions/rates and respirable fractions under accident conditions from a number of nuclear facility conditions. An area of revision is to remove proprietary information [Slide 9].
3. Panel Session Summary from PSA 2013 Topical Meeting on Nonreactor Facility Use of Probabilistic Risk Analysis (PRA) – A link to the draft summary for this panel session from the 2013 Probabilistic Safety Analysis and Assessment conference in Columbia, South Carolina will be added to the H2SIG website [Slide 10]. We will also post the presentations of the six speakers, including Jim O’Brien (DOE/HSS), Yoshinori Ueda (Japan Nuclear Energy Safety), Mike Frank (Hanford WTP), Dennis Damon (U.S. NRC Staff), Jeff Shackelford (DNFSB Staff), and Dennis Heinneke (GE-Hitachi).

Two contributed topics were then discussed. The first was the ongoing analysis of potential deflagrations/detonation conditions in repackaging of waste for the TRU Waste Processing Center (TWPC) at Oak Ridge. Although she could not participate, a short brief by Karen Balo on UCOR’s and WAI’s status was summarized [Slide 11] as follows. Oak Ridge has 30 year-old containers of plutonium oxides with layered packaging. The packaging is typically a pipe nipple or plastic bottle inside two nested food pack cans, inside a 2R, inside a 6M drum, and nested in a 55-gallon drum [Slide 12]. The

deflagration/detonation concern centers on hazards associated with opening these containers for repackaging in WIPP compliant containers. The containers are currently in storage under the UCOR contract and would be processed by the contractor for the Transuranic Waste Processing Center that is presently managed by WAI. The two contractors have worked jointly on this issue.

Kirk Veirs from Los Alamos National Laboratory was heavily involved in determining the initial amount and associated partial pressures of hydrogen and oxygen [Slide 13]. DOE-STD-3013-2012 (*Stabilization, Packaging, and Storage of Plutonium-Bearing Materials*) addresses ingrowth of hydrogen but not oxygen. Other studies on the nested configuration of 3013 containers show that the nested configuration shortens the Length/Diameter ratio sufficiently to result in the possibility of a transition of a deflagration to a detonation. As would be expected, there is significant uncertainty with respect to amount of oxygen available in the subject configuration after a long period of storage.

Calculations estimating hydrogen and oxygen production are nearing completion. BlazeTech has analyzed concentrations to determine which containers represent a deflagration versus a detonation hazard [Slide 14]. Currently, a contract is being pursued with George Antaki (Becht Nuclear) to understand the event progression and consequences of detonation. Karen requested that any thoughts or suggestions be directed to her at [karen.balo@ettp.doe.gov](mailto:karen.balo@ettp.doe.gov). One meeting participant responded that analysis for the K Area Material Storage (KAMS) facility at the Savannah River Site may have similar repackaging issues and suggested that accident analysis group for KAMS be contacted.

A second contributed topic for discussion was submitted by Jackie East of the BWCS Depleted Uranium Hexafluoride (DUF6) Project at Paducah [Slide 15]. Jackie said that the DUF6 Conversion Project currently produces hydrogen using commercially available generating units, and that the hydrogen is used in the facility's DUF6 stabilization process. However, they are looking to replace the current units with a combination of larger units and commercial tube trucks. Any lessons learned from other nuclear facilities producing hydrogen or having bulk flammable storage would be greatly appreciated by Jackie ([jxeast@duf6.com](mailto:jxeast@duf6.com); 270-538-2282). A participant later suggested that the NRC's MOX Fuel Fabrication Facility at SRS may have information in this area. This facility is planning to use inert gas + 6% hydrogen in the sintering process of MOX fuel at SRS. The names of two technical staff were recommended to Jackie to talk to on their planned hydrogen safe practices.

The meeting closed without any new business items being identified [Slide 16]. There was some concern voiced about folding H2SIG into the Accident Analysis Subgroup and whether that would detract from sharing information in hydrogen and flammable gas safety issues and convey the impression that this topic is not being tracked adequately. Kevin and Roger Lanning reiterated that regardless of the SAWG realignment, the same level of activities in H2SIG would continue and that we would maintain a presence in EFCOG. Kevin asked that anyone interested in becoming a vice-chair to let him know. Finally, the next telecon of H2SIG is planned for November 13, 2014. **Note: Due to availability issues the call was carried out on December 9, 2014 at 7:00 AM (Pacific)/8:00 AM (Mountain)/10:00 AM (Eastern) and 3:00 PM (15:00) UK.**

Attachment 1. AA and H2SIG Meeting Attendees, October 13, 2014

AA Subgroup Meeting  
& H2SIG -  
October 13, 2014

#	Name	Organization	Email
1.	Kevin O'Kala	URS Prof. Solutions	kevin.okala@urs-ps.com
2	TERRY FOPPE	Foppe Associates, Inc	terryfoppe@comcast.net
3.	MIKE LEHTO	INL-BEA	michael.lehto@inl.gov
4.	ANGELA MUSTARD	NNSA/NPO/PX	angela.mustard@npo.doe.gov
5	GARY FRANCIS	HUKARI/ASCENDER	fgf68@comcast.net
6	Ingle Park	WRPS/One System	ingle_park@rl.gov
7	Thomas Huff	SRR/Nuc Safety	thomas.huff@sis.gov
8	Glenn G. Coppock	ORNL	coppockgg1@ornl.gov
9	Peter Subaiya	SNL	pvsubai@sandia.gov
10	Son Nguyen	LLNL	Nguyen4@llnl.gov
11	Garrett Sm. Th.	DOE	garrett-sm.th@hq.doe.gov
12	Amanda Anderson	DOE	amanda.anderson@hq.doe.gov
13	Will Salyer	ES/SWPF	wsalyer@energysolutions.com
14	Elizabeth Gilbertson	LANL/SB	egilbertson@lanl.gov
15	KAREN McHugh	LANL/SB	mchugh@lanl.gov
16	Chris Chaves	DOE	christopher.chaves@hq.doe.gov
17	ROBERT NELSON	DOE	robert.nelson@em.doe.gov
18	GAYLE SUGIYAMA	LLNL	sugiyama1@llnl.gov
19	AKSHAY GOWARDHAN	LLNL	gowardhan1@llnl.gov
20	Daniel Schmitz	WTP	djschmit@bechtel.com
21	David Compton	DOE/PEC	david.compton@hq.doe.gov
22	James O'Brien	DOE	james.o'brien@hq.doe.gov
23	Charles Carruthers	SNL	cdcarruth@sandia.gov
24	Chin Ma	LLNL	ma6@llnl.gov
25	Kazem Mohammadi	LLNL	kmohammadi@llnl.gov
26	Roger Lanning	WTP	rdlanning@bechtel.com