



Lithium Handling Experience at Sandia

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“usual players”
Fusion Technology

Participants
in Li fire
Demo

ALPS Meeting

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Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.



Sandia Li Handling Experience

- Battery Program at Sandia handles lithium and works with static Li pools.
- Sandia Fusion Technology developed safety procedures (documented) e.g., Operating Procedure for Li handling. *(previously reported and distributed)*

Our people are trained;
appropriate equipment
is always on hand.

- We have filled casks with Li ingots in an Ar atmosphere in our glove box, and have piped molten Li from the casks into our furnace chamber.
- A Li stream was introduced in LIMITs.



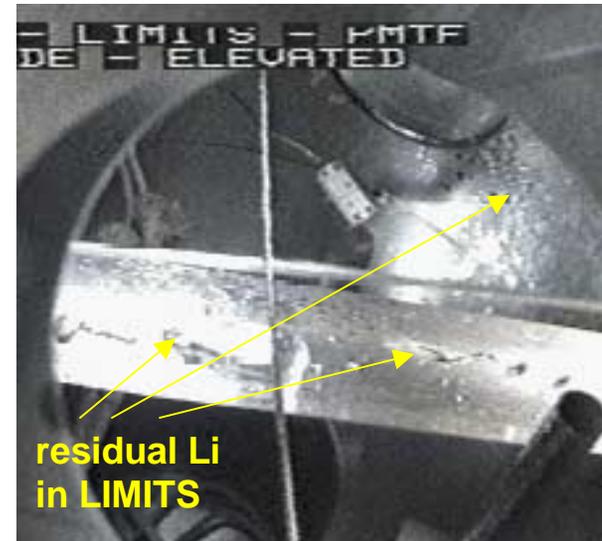
Li on inside
of transfer
cask after Li
transfer to
furnace



Sandia Li Handling Experience continued

- **Lithium cleanup** - We routinely clean Li from containers, tools, seals, etc. by wiping with isopropanol and then water. We react small amounts of Li from (cold) objects by immersion in a water tank.
- We cleaned LIMITS after our first Li flow experiments.
- We finally conducted a (long-planned) Li Fire Demonstration.
- An unplanned Li fire on 9/13/02 gave us first hand experience with Li fires and our emergency response teams.

valve with Li and Lith-X
and insulation stripped



view through port of "catcher" tray



Demo of Extinguishing Agents for a Lithium Fire

October 2, 2002 (after ~1 year of planning and delay)

Sandia Fire Extinguisher Demonstration Area (Tech. Area 4)

Carlos Trujillo – demo site, Kirtland Air Force Fire Team, Gary Chemistruck - video services

video of demonstration to follow

Various extinguishing techniques (below) were demonstrated.

- Lith-X powder (by hand from can)
- Class D Lith-X extinguisher
- Class A,B,C dry chemical extinguisher
- water spray (“fog” from fire hose)

The degree of control in the rate of application with the Lith-X extinguisher was very good.

In the last part of the video, molten Li and water spray ignite with no external ignition source.

In the video, small solid pieces of cool lithium immersed in the water on the pad safely react slowly with water.

In the lab we clean parts by immersion in water*.

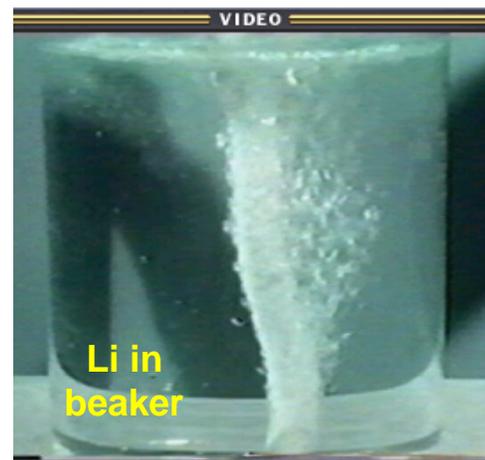


Photo from Chemtall-Foote video

*This creates a highly basic hydroxide solution that requires proper disposal.

*Li Fire Demo Video
(still images)*

In the video, please look for the following:

Li fire is very localized to surface.

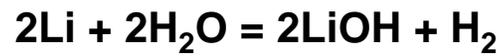
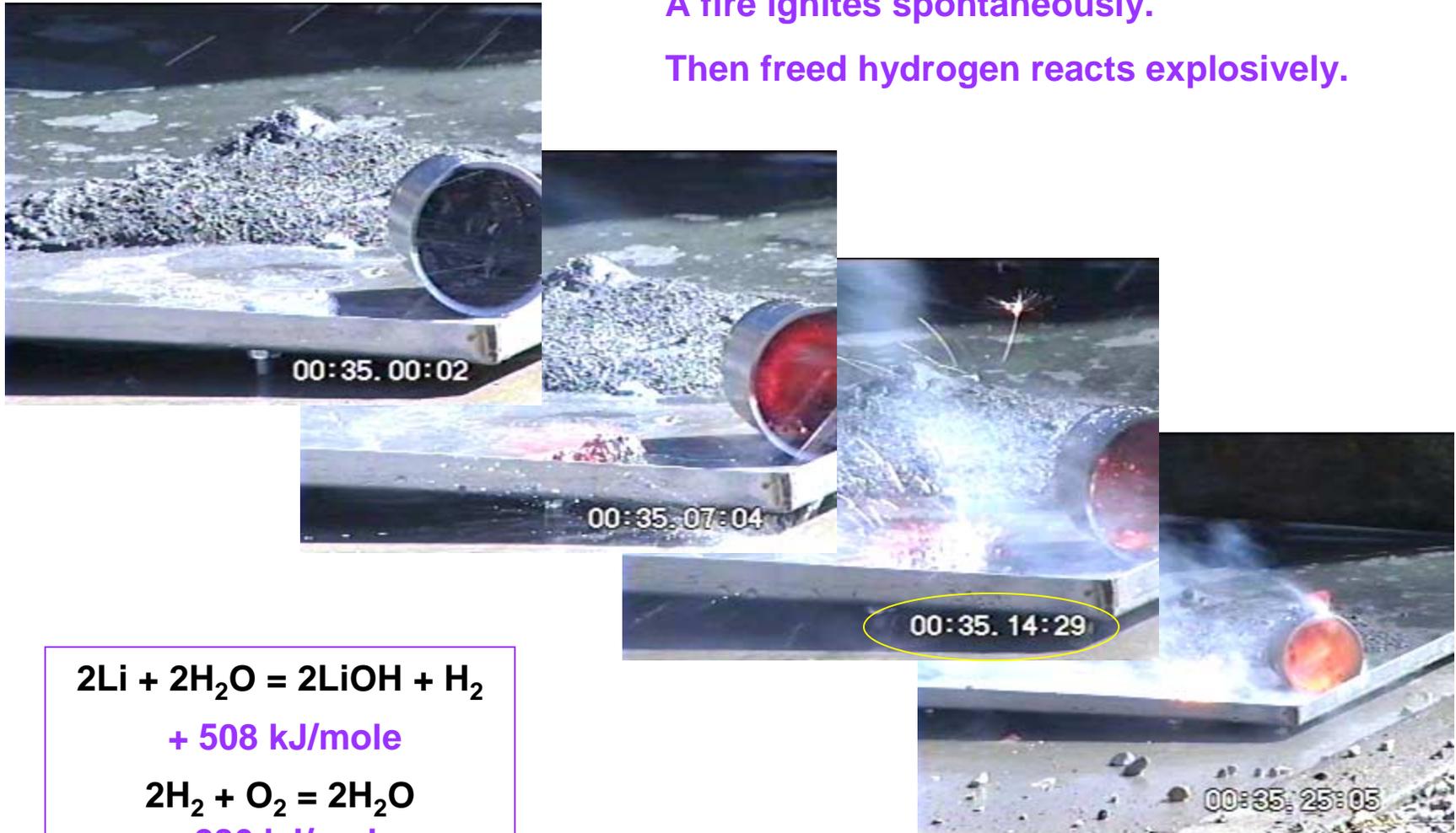
Lith-X is easily applied by hand or with a Class D extinguisher.

Forceful spray from a Class A,B,C extinguisher moves the lithium and increases burning surface area.

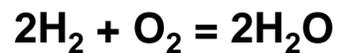
Water does not extinguish the fire.



With molten Li, water is a strong reactant.
A fire ignites spontaneously.
Then freed hydrogen reacts explosively.



+ 508 kJ/mole



+ 286 kJ/mole

Lithium Fire 9/13/02 – (excerpts from notes compiled by Tanaka)

.. 30 psi .. no flow.. (9:27AM) opened valves... **saw puff of white smoke near ¼” line.**
.... more gas flowing than .. bubbles in the transfer chamber

we realized we had to take the insulation off

Jimmie suited up ... *apron, face shield, aluminized heat shields* for feet and arms, *leather gloves* and *heat resistant gloves*.

we realized there was a fire .. aluminized covering was glowing and melted.

Jimmie asked for *metal containers* and *scissors*

Fred **turned off all heater controllers.**

Jimmie cut away **insulation containing Li .. placed it in *metal containers*, exposing the burning area.**

Meanwhile Tina called **911 to report fire (9:47)**

Jimmie **scooped *Lith-X* onto the burning areas** ... continued to cut away and cover burning insulation with *Lith-X* until it was all covered. [Others] opened doors ... turned on *ventilation*,... *HEPA filtered vent*

.. *cans* of insulation, lithium and Lith-X were taken outside the lab. ... heater power ... was unplugged ..

**Our response was good.
Lab people knew what to do.**



Italicized words denote equipment on hand

Lithium Fire 9/13/02 – (excerpts from Tanaka notes)

The original plan was to have no copper gaskets

.. a copper gasket ... was not removed when the furnace and transfer chamber were connected, instead, a flange ...

[after previous water flow simulation in LIMITs]

..an increase in height of the tube coming out of the furnace
.. was **noticed and puzzled over, but the reason for the change in height was not apparent because the line had already been insulated.**

On connecting the transfer vessel to the furnace.... misaligned.
But since the misalignment was easily overcome by slightly bending the transfer line, the misalignment was ignored.



We now require an independent safety inspection by a technical person not involved in performing the experiment.

Their concern is only with safety and not whether the experiment starts on time.

Coordinating with Emergency Response Teams

- Info**
- **researchers:** lab layout, summary of hazards (HV, pressure, ..), operating procedures, status of equipment and personnel – all accessible in the event of an emergency and evacuation
 - **response team:** familiarity with site, plan specific to a Li fire (as opposed to a “worst case” with radiation or other hazard), plan for decontamination of personnel and equipment

- Other Issues**
- **“calling the shots”:** Will responders listen to, understand and trust the researchers regarding the fire, hazards, etc.?
 - Li operation was considered as an ordinary lab hazard; no special information was sent to the incident commander ahead of time.
 - Fire response team’s standard (written) procedure, lacking other specific directions, would have been to flood the Li fire with water.

Our lab personnel intervened to prevent this!

Coordinating with Emergency Response Teams (continued)

Equipment & Training

- equipment for a Li fire (Lithex, protective gear, breathing apparatus)
- training to recognize fire location and severity, to use appropriate equipment and to decontaminate personnel

Other Issues

- *rule:* Sandia lab people cannot use self-contained breathing apparatus because they are not a “first response” team.

Decon

- A small amount of solid or molten Li landing on a person’s skin will react with the moisture there. Rinsing the area immediately with a lot of water is the preferred treatment. Inhaled contamination (lithium oxide “smoke”) can irritate lungs.

Other Issues

- Lacking knowledge of Li decon techniques, response team isolated and immobilized lab people rather than provide appropriate decon.