**NOTEBOOK NO.** 504

**ISSUED TO** DARIUS DARUWALLA

**ON** Feb 20, 2002

**DEPARTMENT** CSPE

**RETURNED**



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(210)-522-3297

This Notebook is used for preparation of the report on the DOE Surface Fire Hazard Analysis for the Repository at Yucca Mountain.

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TLE DOE Surface Fire Hazard Analysis Book No. 504

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Subject: Explore Possible Issue of Zirconium as a Combustible

Heat of Combustion of Zirconium:

Zirconium oxidation is an exothermic reaction with an energy release of 262 K cal/mole. The heat generated will therefore tend to sustain the reaction, once started. (Draft Final Technical Study of Spent-Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants, Feb. 2000.

Heat of Combustion Calculations:

$$\text{Heat of Combustion for Zirconium} = \frac{262{,}000 \text{ cal}}{91 \text{ gm Zr}}$$

~~= (262, cal~~ DDD. 2/20/02

$$= \frac{\left(262{,}000 \text{ cal} \times \frac{1 \text{ Btu}}{252 \text{ cal}}\right)}{\left(91 \text{ gm Zr} \times \frac{1 \text{ lb}}{454 \text{ gm}}\right)} = 5{,}200 \frac{\text{Btu}}{\text{lb.}}$$

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To Page No. ______

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Estimate of Fire Load from Combustible Zirconium Cladding In Assembly Handling Cell (AHC)

There are 2 dryers + 1 Disposal Container in AHC. (CRWMS M&O, 2000, WHB/WTB Space Program Analysis for Site Recommendation, Rev 00)
The Disposal Container will hold around 21 PWR spent fuel assemblies (Science & Engineering Report, DOE 2001)

Assume there are 8 PWR Spent-Fuel Assemblies ~~and~~ in [DDD] the dryers and 21 PWR Spent Fuel Assemblies in the Disposal Container at the time of the fire.

DDD 2/20/02 ∴ ~~Mass~~ No of Zircoloy in the Assembly Handling Cell = (8+21) assemblies = 29 PWR Assemblies

There are 102.9 kg of Zircoloy-4 in the cladding of a PWR assembly, and 51.2 kg of Zircoloy-2 in the cladding of a BWR assembly + 41.7 kg of Zircoloy-4 in the fuel channel of a BWR assembly (Waste Form Characteristics Report, Rev. 1, LLNL, Livermore, Ca, April 1997)
DDD 2/20/02

∴ Mass of Zircaloy in the AHC = 29 ~~Assemblies~~ × 102.9 kg Zircalo / assembly

= (29 × 102.9) ~~kg~~ × 2.2 lb/kg

= 6,565 lbs

∴ Mass of Zircaloy in AHC ≃ <u>6,600 lbs</u>

∴ Fire Load in AHC can be estimated at (6,600 ~~lbs~~ Zr × 5,200 Btu / ~~lb Zr~~) ≃ <u>34 × 10⁶ BTU</u>

∴ Zirconium is by far the most prevalent combustible in the Assembly Handling Cell.

Also, the fire suppression system in this area must be suitable for zirconium fire suppression, in accordance with NFPA 482.

However, the DOE has excluded zirconium as a combustible in its analysis for the present (Preliminary Preclosure Safety Assessment for Monitored Geologic Repository Site Recommendation. Rev 00 ICN 03).

At the very least, therefore, it is important to track this issue in the DOE final design.

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Project No. ________

Book No. ________ TITLE ________________________________

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To Page No. ________

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Project No.
Book No.

TITLE

From Page No.

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To Page No.

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Project No

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3/22/02

To Page No.

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TITLE

From Page No.

DDD
3/22/02

To Page

| Witnessed & Understood by me | Date | Invented by | Date |
|---|---|---|---|
| | | Recorded by | |

Project No.
Book No. TITLE

From Page No.

SDW
3/22/02

To Page No.

| Witnessed & Understood by me, | Date | Invented by | Date |
|---|---|---|---|
| | | Recorded by | |

Project No.

TITLE Book No.



From Page No.

DDD
3/22/02

To Page No.

| Witnessed & Understood by me, | Date | Invented by | Date |
|---|---|---|---|
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Project No. ______
Book No. ______ TITLE ______

From Page No. ______

DDD
3/22/02

To Page No. ______

Witnessed & Understood by me, | Date | Invented by | Date
Recorded by

TITLE DOE Surface Fire Hazard Analysis

Project No. ______

Book No. 504

From Page No. ______

Subject: Explore possible issue of fire in Carrier Prep. Bldg. and Carrier Bay of Waste Handling Bldg.


**From:** Amitava Ghosh [aghosh@swri.edu]
**Sent:** Friday, March 01, 2002 3:09 PM
**To:** Darius Daruwalla
**Cc:** Asadul Chowdhury


**Subject:** RE: Discussion on February 28, 2002

aghosh.vcf

Darius:

This email summarizes the discussion I had with you yesterday (February 28, 2002) on fire hazard assessment for surface facilities at Yucca Mountain.

(1) PFSF SER gives summary results of fire calculations because of its nature. PFS SAR gives more details and also refers to HI-STORM 100 FSAR for relevant analyses for fire hazard to a storage cask.

(2) As discussed, before, we need to evaluate the operations in the Waste Handling Building regarding how the casks are brought inside -- either using locomotives, or heavy-haul trucks/cask transporters. We also need to evaluate the capacities of the fuel tanks and number of such vehicles staying inside the building at one time. We also need to evaluate the closest distance these vehicles can come close to the SSCs that may be affected by fire. We also need to evaluate the floor configurations at the site to evaluate the fire characteristics.

(3) As discussed before, we may not have all information that we need for an acceptable fire hazard analysis right now but will be looking for eventually.

(4) As discussed, capacity of the fuel tank of a fork lift is significantly small compared to a cask transporter, a heavy-haul truck, or a locomotive. Although it is good to know and should be included in the inventory, its contribution may not be significant.

If you remember any other issues we discussed, please let me know. I will included in this list.

Amit Ghosh

D.D.D. 3/1/02

To Page No. ______

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# Fire - Additional Issues

1. **Issue:** The DOE has not provided sufficient analyses or calculations to demonstrate that the breach of a transport cask due to a fire in the Carrier Preparation Building or the Carrier Bay of the Waste Handling Building is incredible.

**Basis:** The DOE has stated that " there is no credible means by which a fire in the Carrier Preparation Building or carrier bay of the Waste Handling Building could cause a breach of a transport cask" (CRWMS M&O 2001). Transport casks entering the MGR are designed to withstand the severe transportation fire environment specified by 10 CFR 71.73 *Hypothetical Accident Conditions.* Therefore a Design Basis Fire would have to exceed the size and duration of such fires, to cause a breach in the cask. However, since there may be multiple diesel fuel driven vehicles at one time in either these two locations, the total fuel inventory in each area may be considerable. For example, there could be two diesel prime movers and a 20 ton forklift ( CRWMS M&O 2000c) in the carrier bay of the Waste Handling Building, resulting in a total inventory of diesel fuel far in excess of the capacity of one vehicle. It is not clear if this has been considered by the DOE in their analyses.

**Recommendation:** The DOE should provide confirmatory analysis or calculations to demonstrate that the breach of a transport cask due to a fire in the Carrier Preparation Building or the Carrier Bay of the Waste Handling Building is incredible, or limit the total allowable fuel inventory in these locations to a safe maximum capacity. The DOE should specify this maximum allowable capacity.

This comment (issue) in draft form was generated by me and given to Asad for comment on March 1, 2002 around 5:30 pm.
My approach was based on the arguement that there could be multiple diesel powered vehicles in the locations of interest. Therefore the total diesel fuel inventory could exceed the capacity of one diesel powered vehicle. The assumption is that "10 CFR 71.73 Hypothetical Accident Conditions" is based on the hypothetical fire from one diesel vehicle pulling the carrier loaded with a transportation cask (i.e. "Normal Conditions of Transport"). SDD ~~3/3~~ SDD 3/1/2002.

From Page No.

### 8.3.4 Design/Operational Features for Prevention/Mitigation of Fire-Initiated Radiological Events

Features of the MGR operations and facility design that prevent or mitigate the effects of the potential fire-initiated radiological hazard are described in the following paragraphs.

Transport casks entering the MGR are designed to withstand the severe transportation fire environment specified by 10 CFR 71.73, *Hypothetical Accident Conditions*. Therefore, a radiologically significant design basis fire for the carrier preparation area and the carrier bay would have to exceed the size and duration of such fires. The FHA for the CPB shows that the fire level is moderate and, therefore, there is no credible means by which a fire in the CPB or carrier bay of the WHB could cause a breach of transport cask and a release of radioactivity.

Ask for DOE Analysis

Similarly, waste packages will be designed to withstand the same fire environment as transportation casks. The FHAs show that only low to moderate fire hazards exist in the primary functional areas of the WHB and the subsurface facilities, so it is unlikely that any credible fire in the WHB will approach the severity of a design basis fire for a transport cask. Therefore, after completion of the final seal weld, a fire-induced breach of a waste package is not credible at any point in the waste stream beyond the welding station inside the WHB.

Elsewhere in the WHB, bare SNF assemblies and sealed HLW canisters are handled. These operations are performed within the robust, non-combustible confinement structure provided by the WHB. The FHA shows that the fire hazard level is low to moderate for these operations areas. A design basis fire for these areas has to have temperature and duration sufficient to cause a breach of SNF cladding or HLW canister. It is unlikely that fires of sufficient severity can occur. Even if a release of radioactivity occurs, the radioactivity would be confined by the robust structure of the WHB and the confinement provided by the HVAC system. Further, the



From: Preliminary Preclosure Safety Assessment for Monitored Geologic Repository Site Recommendation.

The above is a copy of the DOE document (CRWMS M&O 2001) referenced in "Basis" section of my draft issue on pg #12 of this ~~report~~ notebook.

D.D.D. 3/1/2002

To Page No.

Witnessed & Understood by me, Date | Invented by | Date

Recorded by

(4) *Thermal*. Exposure of the specimen fully engulfed, except for a simple support system, in a hydrocarbon fuel/air fire of sufficient extent, and in sufficiently quiescent ambient conditions, to provide an average emissivity coefficient of at least 0.9, with an average flame temperature of at least 800°C (1475°F) for a period of 30 minutes, or any other thermal test that provides the equivalent total heat input to the package and which provides a time averaged environmental temperature of 800°C. The fuel source must extend horizontally at least 1 m (40 in), but may not extend more than 3 m (10 ft), beyond any external surface of the specimen, and the specimen must be positioned 1 m (40 in) above the surface of the fuel source. For purposes of calculation, the surface absorptivity coefficient must be either that value which the package may be expected to possess if exposed to the fire specified or 0.8, whichever is greater; and the convective coefficient must be that value which may be demonstrated to exist if the package were exposed to the fire specified. Artificial cooling may not be applied after cessation of external heat input, and any combustion of materials of construction, must be allowed to proceed until it terminates naturally.

(5) *Immersion—fissile material*. For fissile material subject to §71.55, in those cases where water inleakage has not been assumed for criticality analysis, immersion under a head of water of at least 0.9 m (3 ft) in the attitude for which maximum leakage is expected.

(6) *Immersion—all packages*. A separate, undamaged specimen must be subjected to water pressure equivalent to immersion under a head of water of at least 15 m (50 ft). For test purposes, an external pressure of water of 150 kPa (21.7 lbf/in$^2$) gauge is considered to meet these conditions.

### §71.74 Accident conditions for air transport of plutonium.

(a) *Test conditions—Sequence of tests*. A package must be physically tested to the following conditions in the order indicated to determine their cumulative effect.

(1) Impact at a velocity of not less than 129 m/sec (422 ft/sec) at a right angle onto a flat, essentially unyielding, horizontal surface, in the orientation (e.g., side, end, corner) expected to result in maximum damage at the conclusion of the test sequence.

(2) A static compressive load of 31,800 kg (70,000 lbs) applied in the orientation expected to result in maximum damage at the conclusion of the test sequence. The force on the package must be developed between a flat steel surface and a 5 cm (2 in) wide, straight, solid, steel bar. The length of the bar must be at least as long as the diameter of the package, and the longitudinal axis of the bar must be parallel to the plane of the flat surface. The load must be applied to the bar in a manner that prevents any members or devices used to support the bar from contacting the package.

(3) Packages weighing less than 227 kg (500 lbs) must be placed on a flat, essentially unyielding, horizontal surface, and subjected to a weight of 227 kg (500 lbs) falling from a height of 3 m (10 ft) and striking in the position expected to result in maximum damage at the conclusion of the test sequence. The end of the weight contacting the package must be a solid probe made of mild steel. The probe must be the shape of the frustum of a right circular cone, 30 cm (12 in) long, 20 cm (8 in) in diameter at the base, and 2.5 cm (1 in) in diameter at the end. The longitudinal axis of the probe must be perpendicular to the horizontal surface. For packages weighing 227 kg (500 lbs) or more, the base of the probe must be placed on a flat, essentially unyielding horizontal surface, and the package dropped from a height of 3 m (10 ft) onto the probe, striking in the position expected to result in maximum damage at the conclusion of the test sequence.

(4) The package must be firmly restrained and supported such that its longitudinal axis is inclined approximately 45° to the horizontal. The area of the package that made first contact with the impact surface in paragraph (a)(1) of this section must be in the lowermost position. The package must be struck at approximately the center of its vertical projection by the end of a structural steel angle section falling from a height of at least 46 m (150 ft). The angle section must be at least 1.8



Fire Criteria from 10 CFR Part 71.73 D.W.D. 3/1/2002

From Page No. In researching my issue (Pg 12 of this notebook), I also looked at other DOE reports. Attached below are my Notes from an Access Database I have created for this report.

| Remarks | Notes |
|---|---|
| Explore cask resistance to diesel fire accident. Up to two Diesel Prime movers and one 20 ton forklift used in this area. | Min. 20 ft queing space ? between loaded casks (WHB/WTB pg 23). From this and Fig I-13 assume up to 2 loaded casks in WHB Carrier Bay(WHBCB). See Fig I-13, 14, 15 for distances & configurations. Area of WHBCB 15,680sq ft, ht. 60 ft (WHB/WTP pg 24). Onsite diesel-driven prime movers (rail or tired vehicle) used (PPSA Rev 3 pg 4-5). Truck carriers one-way drive through. Rail carriers enter & leave from same end of carrier bay. 20 ton Forklift diesel with ~30 gal tank (Hyster Co.). Truck Site Prime Mover = 48 ton capacity, Rail SPM = 290 ton capacity (Carrier/Cask Prep & Transportation Systems Design Analysis Rev 00B pg 31). There are 3 truck and 3 rail SPMs, truck SPM 15 to 23 ft long, rail SPM 153 inches long; truck carrier ~42 ft long, rail carrier ~72 ft long (Eng Files for site Recommendatn Att II pg 115; Att I Fig I-7 to 10). |

D.D.D 3/1/2002



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March 4, 2002 (9:34AM)

# Comments on Fire–Additional Issues by Darius Daruwalla (March 1, 2002)

*Amitava Ghosh*

The basis, as presented, does not establish it a valid comment as we have not established the credibility of the fire scenario as envisioned by us. A significant amount of work is needed before the comment can be a valid one. Some reasons are:

- ☐ We need to know what are the fire criteria under Part 71.
- ☐ We need to know the storage tank capacity of each prime mover and 20-ton forklift.
- ☐ We need to know the layout of the transportation cask handling areas of these two buildings to determine the fire load (i.e., heat applied on a transportation cask) will be a simple multiplication of the number of prime movers present.
- ☐ We need to check any discussion of operational procedure that may limit the number of prime movers at one time inside these buildings.
- ☐ Based on this information as a minimum, we need to establish that the fire load that may be present exceeds the analyzed conditions under Part 71. Only then this comment, as written, is a credible and useful comment.

This comment, in my opinion, deals with confirmatory calculations and analysis that give a notion that we have investigated thoroughly DOE's analyses and calculations, and find an unanalyzed scenario. As far as I know, we do not have that much of the information to make such a strong comment at this moment. In my opinion, this comment should be presented in a different form. Several discussions I had on this topic and discussion summary of last Friday may lead to one possible way of framing the comment. Obviously, there are several approaches to tackle this issue. I do not understand why we are asking DOE for the maximum allowable capacity when DOE is following or has followed Part 71 fire criteria.

**Note**: The above comment is solely based on the text presented in the above-mentioned document and preliminary knowledge of DOE status of progress on this area. However, I have not read DOE fire hazard analysis in detail to know exactly what information is available at this moment. Still, in my opinion, we need to answer the above steps to present a valid comment to the DOE, as given in the above-mentioned document, otherwise present in a different way. I did not revise or rewrite this comment as it defeats the purpose of assigning somebody the review responsibility.

The above are Amit's comments to my draft issue (see pg 12 of this notebook). These comments were forwarded to me by Asad at our meeting of March 8, 2002 around 6pm. Based on these comments, I researched this issue further. DDD 3/8/2002

TITLE DOE Surface Fire Hazard Analysis.

Project No.

Book No. 504

From Page No.

## Estimate of Diesel Fuel Needed to Sustain a 10 CFR 71.73 Hypothetical Accident Conditions Fire

Required Fire Temperature & Duration and Size:
(From ~~B~~ SDD 10 CFR 71.73)

- Average flame temperature of 800 °C for a period of 30 minutes.
- Fuel Source must extend horizontally at least 1 m (40") beyond the external surface of the specimen.

METHOD 1:

From HI-STORM TSAR Report HI-951312 we have, (Pg 11.2-10)

50 gallons of fuel will burn in 3.622 minutes.

50 gal diesel fuel pool:

Based on the 50 gallon fuel volume, the overpack outer diameter and the 1 m fuel ring width, the fuel ring surrounding the overpack covers 147.6 $ft^2$ and has a depth of 0.54 in. From this depth and a linear fuel consumption rate of 0.15 in/min, the fire duration is calculated to be 3.622 minutes (217 seconds). The linear fuel consumption rate of 0.15 in/min is the smallest value given in a Sandia Report on large pool fire thermal testing [11.2.2]. Use of the minimum linear consumption rate conservatively maximizes the duration of the fire.

$$\therefore \text{Fuel Consumption Rate} = \left(\frac{50\ \text{gal}}{3.622\ \text{min}}\right) = 13.81\ \text{gal/min}$$

$$\rightarrow = 14\ \text{gal/min}$$

$$\therefore \text{Fuel required to Sustain 10 CFR 71.73 fire} = (14\ \text{gpm} \times 30\ \text{min})$$

$$\rightarrow = 420\ \text{gals}$$

∴ You need > 420 gal of diesel fuel to damage transport cask from fire.

To Page No.

| Witnessed & Understood by me, | Date | Invented by | Date |
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SDD 3/11/02

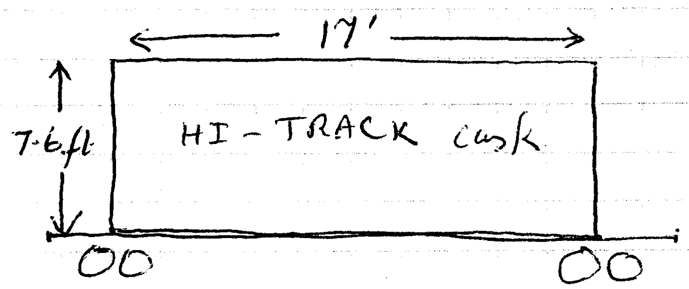
METHOD 2: To gain confidence in the result from Method 1 on Pg 17 of this notebook, a second calculation was made.

From HI-STORM TSAR Report HI-951312 (Pg 4.5-4) we have: for the HI-TRACK cask, the dimensions are:

Height of HI-TRACK = 17 ft

~~Da~~ ADD Diameter " " ≃ 7.6 ft.

Turbulent natural convection correlations are suitable for use when the product of the Grashof and Prandtl (Gr×Pr) numbers exceeds $10^9$. This product can be expressed as $L^3 \times \Delta T \times Z$, where L is the characteristic length, $\Delta T$ is the surface-to-ambient temperature difference, and Z is a function of the surface temperature. The characteristic length of a vertically oriented HI-TRAC is its height of approximately 17 feet. The value of Z, conservatively taken at a surface temperature of 340°F, is $2.6 \times 10^5$. Solving for the value of $\Delta T$ that satisfies the equivalence $L^3 \times \Delta T \times Z = 10^9$ yields $\Delta T$ = 0.78°F. For a horizontally oriented HI-TRAC the characteristic length is the diameter of approximately 7.6 feet (minimum of 100- and 125-ton designs), yielding $\Delta T$ = 8.76°F. The natural convection will be turbulent, therefore, provided the surface to air temperature difference is greater than or equal to 0.78°F for a vertical orientation and 8.76°F for a horizontal orientation.

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From 10 CFR 71.73, for Hypothetical Accident Case fire, we have a requirement that the fuel source must extend horizontally at least 1 m (40") beyond the external surface of the cask (see Pg 14 of this notebook)

We can therefore calculate the required surface area of the diesel fuel pool needed to satisfy this requirement as follows:

Cask Area = (17 ft × 7.6 ft) = 129.2 $ft^2$
(In horizontal Orientation)

If diesel pool extends 1 m (40") beyond cask, then

Diesel Pool Area = ((17+3.3) ft × (7.6+3.3) ft) = (20' × 11')
↳ ≃ 220 $ft^2$

From NFPA 92B Table B.5.2 (a) "Unit Heat Release Rate for Commodities" (2000 edition) we have:

Heat Release Rate for Diesel Oil = 175 BTU/sec $ft^2$

∴ Heat Release Rate from Diesel Fuel Pool = $\left(175 \frac{BTU}{sec \cdot ft^2} \times 220 ft^2\right)$

$= 38,500 \frac{BTU}{sec} = 2.31 \times 10^6 \frac{BTU}{min}$

Diesel Fuel = 19,400 $\frac{BTU}{lb}$ (WVNS FHA Pg 31)

Diesel Fuel Density = $\left(\frac{1608 \text{ lbs}}{200 \text{ gals}}\right) = 8.04 \frac{lb}{gal.}$ (WVNS FHA Pg 31)

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∴ Diesel Fuel Pool Burn Rate =

$$\left(2.31\times10^{6}\ \frac{BTU}{min}\times\frac{lb}{19{,}400\ BTU}\times\frac{gal}{8.04\ lb}\right)\frac{gal}{min}$$

∴ Fuel Consumption Rate from 220 $ft^2$ pool = 14.81 gpm

∴ Fuel required to sustain 10 CFR 71.73 fire = (14.8 gpm × 30 min)
= 444 gals.

This result agrees well with result from Method 1 on page 17 of this notebook.

∴ You need > 450 gallons of diesel fuel to damage transport casks from fire

DDW 3/12/02

The Waste Handling Bldg Carrier Bay may have 2 prime movers and one 20 ton forklift (from pg 12 of this notebook). Further, a Rail Site Prime Mover has a capacity of 290 tons. (from pg 15 of this notebook).

Estimation of Diesel Fuel Inventory in WHB Carrier Bay with 2 Site Prime Movers + Forklift

I investigated several internet sites for information on the diesel fuel tank size for diesel locomotives. I found that tank sizes varied from around 600 gallons (for switcher locomotives used to shunt rail cars in railway yards) to around 2000 gallons for large cross-country locomotives. Information from the web search has been pasted on the pages that follow.

I focused on the rail site prime mover as it had a much larger capacity of 290 tons compared to the truck (48 tons).

Conclusion: Using the 600 gall tank capacity (smallest) for each site prime mover, you can easily exceed the 450 gallon requirement for diesel fuel given on pg 20 of this notebook, and can damage transport casks from fire. DDD/3-14-02

Note, This conclusion has been changed. See calcs on pg 28 of this notebook. AWW 3/28/02

Project No.
Book No. 504 TITLE DOE Surface Fire Hazard Analysis.

From Page No.

## Darius Daruwalla

**From:** gelwood [gelwood@dnaco.net]
**Sent:** Thursday, March 14, 2002 1:00 PM
**To:** Darius Daruwalla
**Subject:** Re: Typical Diesel Fuel Tank Size

The typical fuel tank for a switcher is 600 gals. This could last several days depending on how high the engines is operating.

Many industrial railroads are getting older road switchers. These are higher horsepower (1500- 1800 HP) and have a larger fuel tanks, approx 1500 gals. This should last about a week, again depending on how high the engine is required to run. The speed of the diesel engine depends on the weight of the cars being moved.x

George Elwood
http://www.dnaco.net/~gelwood

On Thu, 14 Mar 2002, Darius Daruwalla wrote:

> Hi,
>
> I have read with intwerest your impressive list of BLW switcher operator
> manuals at your website.
>
> I am interested in information on the average size for the fuel tank of a
> diesel locomotive to be used to haul a 300 ton rail carrier to and from
> locations within an industrial site. I am researching this in connection
> with the fire potential of the fuel. Any information you may be able to
> provide would be greatly appreciated. Perhaps you may be able to point me
> to an industry standard reference where this information may be available.
>
> Thanks in advance for your help.
>
>
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3/14/02

To Page No.

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**Information potentially subject to copyright protection was redacted from this location. The redacted material is from the website listed above regarding fuel tank specifications.**

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Page No.

Project No.
Book No. 504 TITLE DOE Surface Fire Hazard Analysis.



From Page No.

Explore Adequacy of the WHB Control Rm. Design

Functions: The control Room will be used to: (1) Monitor operations and status of the Local Control Centers (i.e. Consoles in operating galleries), and (2) Provide emergency response to local off-normal events. (Engineering Files for Site Recommendation, Rev 00, May 2000; Attachment II Section 1.1.11 pgs 67-69)

Further, the control room is identified as H-119 in WHB/WTB Space Program Analysis for Site Recommendation (Rev 00, 5/22/00; Section 6.2.2.12)

Consequence: Therefore, if Control Room stops functioning due to fire you lose:

1) Capability to monitor status of LCCs.
2) Provide Emergency Response to local off-normal events.

Regulations: 10 CFR 63.112(e)(10) states that you must have: means to permit prompt termination of operations during emergency. 3/19/02

To Page No.

| Witnessed & Understood by me. | Date | Invented by | Date |
|---|---|---|---|
| | | Recorded by | |

TITLE DOE Surface Fire Hazard Analyses	Project No.
Book No. 504	

From Page No.

Discussion:

Engineering Files for Site Recommendation, Rev 00, May 2000 indicates that there will be a WHB Central Control Center ~~Room~~ (CCC); a CCC in the computer center in the Administration Building; and Local Control Centers (LCC) [DDW 3/19/02]

The primary control functions of waste handling operations will be handled from the operating galleries (LCC) where operators will have direct line of sight of the operations.

In emergency response situations, control of safety systems normally operated from LCC may be transfered to WHB CCC.

In addition, ~~a CCC will~~ the CCC in the Admin. Bldg. [DDW] will also provide monitoring and limited emergency control functions for the WHB.

Finally, a redundant emergency panel may be provided in the WHB to provide a backup control center for the WHB CCC. This control panel will provide emergency operations control for operations normally provided by the WHB CCC.

DDW 3/19/02

To Page No.

| Witnessed & Understood by me, | Date | Invented by | Date |
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Conclusions: If the final DOE design does indeed provide the capabilities for emergency control from multiple locations as described on Pg 25 of this notebook, then there appears to be enough redundancy and defense-in-depth features to safely handle fire situations in any of the various control locations. Control Room Designs need to be carefully tracked as the DOE design matures to ensure that the redunancy and defense-in-depth features are preserved. It is also important to study the design details regarding interlocks between controls from the various locations. (i.e. The interlocks should preclude the capability of controlling an operation simultaneously from 2 locations.). Finally, the DOE should clearly identify these control room locations in their fire hazard data sheets in their final design. This is not the case at present. DOE has lumped WHB CCC Room # H-119 together with 33 other spaces in their ~~fire~~ data sheet (page I-9 of ~~Fire~~ WHB Fire Hazards Technical Report, Aug 16, 1999). D.D.D 3/22/02



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TITLE DOE Surface Fire Hazard Analysis — Project No. — Book No. 504 — 7

From Page No.

Information on Fuel Tank Capacity for 20 Ton Forklift

ny - The Industry Leader in Lift Trucks - Products — http://www.hyster.com/products/ice_pneumatic.ac

20 tons
~ 40,000 lbs.

H 360 H = 32 gal
diesel.

Also available in LP Gas (Model H 360 ...
Not available in Gasoline

Max Electric Forklift = 8000 lb
capacity.

Information on 20 ton forklift. Got from Parts dept. of Hyster in San Antonio during a tel. conversation.

**Information potentially subject to copyright protection was redacted from this location. The redacted material was from the website listed above containing forklift specifications.**

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3/22/02

To Page No.

| Witnessed & Understood by me, | Date | Invented by | Date |
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From Page No. ____

Possible damage to Transport Cask from Diesel Fuel Fire In Carrier Bay of Waste Handling Bldg or in the Carrier Prep. Bldg.

Modifications to Method 2 Calculations: (pg. 18 to 20 of this note book)

The calculations carried out to estimate the volume of diesel fuel needed to damage the transport cask from fire on pages 18 to 20 of this notebook were modified to get a more accurate estimate.

From CRWMS M&O Report titled Repository Surface Design Engineering files Report, dated June-10-1999 (BCB000000-01717-5705-00009, Rev. 03) we have:

Maximum Length of Rail Transport Cask = 230 inches (19.2 ft)

Max. Cross Section of Rail Transport Cask = 103 inches (8.6 ft)

(NOTE: Only Max. Dimensions are given)

Therefore, if the diesel fuel pool is to extend horizontally 1 meter beyond the external surface of the transport cask;

SAA 3/28/02

From Page No.

Diesel Pool area = [(19.2+6.6) x (8.6+6.6)] ft = 392 ft²

From NFPA 92B ~~#~~ Table B.5.2 (a) we have: SDD

Heat Release Rate for Diesel = 175 $BTU/ft^2 \cdot sec$

∴ Ht. Rel. Rate from diesel fuel pool = ~~[(175 BTU/ft²~~ SDD.

$= \left[\left(175 \frac{BTU}{ft^2\,sec} \times 392\, ft^2\right) \times 60 \frac{sec}{min}\right]$

$= 4.12 \times 10^6$ BTU/min.

SDD

Diesel Fuel Pool Burn Rate $= \left(4{,}120{,}000 \frac{BTU}{min} \times \frac{1\, lb}{19{,}400\, BTU} \times \frac{1\, gal}{8.04\, lb}\right)$

= 26.47 gpm.

∴ Fuel required to sustain a 10 CFR 71.73 fire = (26.5 gpm x 30 mins)

= 794 gallons.

∴ Estimated volume of diesel fuel to damage the transport cask by fire ≃ 800 gallons.

This volume is larger than that estimated using Method 1 (pg 17 of this notebook). This is not totally unexpected

SDD 3/28/02 To Page No.

| Witnessed & Understood by me, | Date | Invented by | Date |
|---|---|---|---|
| | | Recorded by | |

Project No._______
Book No. 504 TITLE ________

From Page No.___

for two reasons:

1) The referenced HI-STORM TSAR Report calculation is based on the minimum fuel consumption rate (see pg 17 of this notebook). This results in an estimated minimum fuel volume.

2) The calculations shown on this page are based on a rail cask having the maximum allowable dimensions. This results in an estimated maximum fuel volume.

∴ Using the more conservative result from Method 2 shown on pg 29 of this notebook, the capacity of the fuel tank of the rail site prime mover will have to be larger than ~ 800 gallons to pose a potential problem from fire to the transport cask. Since the range of tank capacities is estimated to be 600 to 1,500 gallons for switcher locomotives (see pg 22 of this notebook), damage of a transport cask due to diesel fuel fire may be possible. SND 3/9/02

To Page No.______

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I have reviewed this scientific notebook and find it in agreement with QAP-001. [signature] 4-15-05