APPENDIX E

PACDIV COMMENTS AND WILLBROS RESPONSES

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	95% PRELIM. PLANS		FNL SPCS & PLNS

GOVERNMENT REVIEWERS	NAME/PHONE NO.	A-E	NAME/PHONE NO.
ARCHITECTURAL		ARCHITECTURAL	
STRUCTURAL		STRUCTURAL	
x MECHANICAL	ROY M. KANESHIRO	MECHANICAL	
ELECTRICAL	(808) 474-5331	ELECTRICAL	
CIVIL		CIVIL	
FIRE PROTECTION		FIRE PROTECTION	
SPECS AND EST.		SPECS AND EST.	
OTHER		OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
GENERAL	1	Please address the following items required by the Statement of Services:	
		a. ¶1.b.(3) Evacuation of facility during an emergency, including adequacy of egress and ingress for fire fighters and emergency crews, i.e., adits, elevators, etc.	See revised Section 4.3.2 "Life safety"
		¶1.b.(4) b. Fire safety and prevention for future construction contracts, i.e., are means of egress adequate in the event of an emergency? Are existing policies, regulations, etc. adequate to ensure safe contractor operation in Red Hill? Many contracts involve hot work in the tunnel, use of electrical equipment, etc. Furthermore, there are projects in the mill that involve major repairs	See revised Section 4.6.2.6 "Egress" (New 4.5.5)

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X MECHANICAL	ROY M. KANESHIRO	___ MECHANICAL	
___ ELECTRICAL	(808) 474-5331	___ ELECTRICAL	
___ CIVIL		___ CIVIL	
___ FIRE PROTECTION		___ FIRE PROTECTION	
___ SPECS AND EST.		___ SPECS AND EST.	
___ OTHER		___ OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
		to some of the tanks where large	
		numbers of construction workers will	
		be working in Red Hill.	
		c.¶1.b.(T) Fire extinguishing systems	
		for the Red Hill Complex. Discuss why	See new
		AFFF deluge system was selected.	Section 4.3.1.5
		Discuss other alternatives listed:	"Fire Protection
		gaseous inerting, high expansion foam,	Systems"
		other alternatives (are there other	
		methods available?). Are existing	Yes with installati
		utilities adequate to support these	of emergency generator.
		systems? Is the water supply adequate?	Yes
		Is electrical power available/adequate	
		for any foam/water pumps that may	
		be necessary? Why is an AFFF	See discussion 4.3.1.5
		the best alternative? Do the tunnels	Hose stations +
		need to be protected, other than with	Wheeled dry chemical extinguishers
		the existing water hose stations?	

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___ ARCHITECTURAL
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X MECHANICAL ROY M. KANESHIRO
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___ OTHER

A-E NAME/PHONE NO.

___ ARCHITECTURAL
___ STRUCTURAL
___ MECHANICAL
___ ELECTRICAL
___ CIVIL
___ FIRE PROTECTION
___ SPECS AND EST.
___ OTHER

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
P. 1-4	2	Last sentence: believe "Vye" should be "Wye" (typo).	Williams will Correct TYPO
P. 4-5	3	Section 4.3.1.1, 2nd ¶: There are no hose stations at valved outlets - does the A-E recommend hose stations be installed? Yes - see 4.4.2.5 & revised Exhibit 4.2 (now 4.6.2.6)	
P. 4-6	4	Section 4.3.2, ¶4: Red Hill is a very unique facility. It is not exactly covered by NFPA 101. The facility is a combination of an underground structure, a mine, and underground fuel tank. The fundamental problems that are of concern are means of egress for the occupants (work and frequent visitors) and ingress for the firefighters. Although there are normally only a handful of FISC people in the complex,	Section 4.3.2 has been revised

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X MECHANICAL	ROY M. KANESHIRO	___ MECHANICAL	
___ ELECTRICAL	(808) 474-5331	___ ELECTRICAL	
___ CIVIL		___ CIVIL	
___ FIRE PROTECTION		___ FIRE PROTECTION	
___ SPECS AND EST.		___ SPECS AND EST.	
___ OTHER		___ OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
		there are often large groups of people, like contractors, in the facility for long periods of time. These people may be unfamiliar with the facility so egress may be a problem in the event of a fire. The problem would be exacerbated by smoke and many people trying to get out by using the elevator. The egress problem should also be addressed in terms of the unique nature of the facility rather than NFPA 101 only.	
P. 4-6	5	Section 4.3.2, ¶4: Is the "man-door" to be installed in the existing bulkhead between Critical Infrastructure and Critical Infrastructure the blast door to be provided by Special Project R4-86?	" YES Willbros will change "shall" to "will" be provided by Special Project R4-86

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DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
		If this is so, please change "shall"	
		to "will be provided by Special	
		Project R4-86" for this area....	
P. 4-11	6	Section 4.3.4 Ventilation:	
		a. Is a smoke control system necessary	
		or recommended? No Would such a	No. Sectn. 4.3.4 has
		system be useful to firefighters	been revised
		evacuation, etc.? Fire Dept. brings their own smoke ejection equipment	
		b. Since the fans shut down	
		automatically after the drop track	Revised 4.3.4
		doors closed, would this be a	
		problem if there is a concurrent	
		fire with the flooding? i.e.,	
		would smoke in the tunnels	
		hinder fire fighting and	
		emergency crews?	
		c. In the past, it was said that the	
		firemen would not enter Critical Infrastructure and	

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DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
		the underground pumphouse (S-59) if there was a large, smokey fire in the interior. There is a concern with Red Hill that in the event of a similar fire and someone is trapped inside, there would be no possible rescue or even anyone to fight the fire.	
		Is a smoke control system feasible?	No - Revised Sectn. 4.3.4
		d. Would the existing tunnel lighting/illumination be adequate to guide someone out/in in the event of lots of smoke in the facility?	Yes if connected to emergency power & meet Sectn. 5-9 of NFPA 101, 198_ Edition
P. 4-29	7	Section 4.6.2.5 Egress: See comment item no. 1.a. and 1.b. above.	See previous comm
P. 4-31	8	Section 4.6.2.8, top two ¶: Put all recommendations at end of section to be consistent.	Sectn. revised

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CIVIL		CIVIL	
FIRE PROTECTION		FIRE PROTECTION	
SPECS AND EST.		SPECS AND EST.	
OTHER		OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
P. 4-31	9	Section 4.6.2.9, Fire Suppression: a. Provide a concept sketch of the recommended AFFF deluge system. b. Discuss why AFFF deluge system was selected, i.e., why not other alternative systems? Also, see comment item no. 1.c. above.	see Exhibit 4-1; See Sectn. 4.3.15
P. 4-31	10	Section 4.6.2.10, Ventilation: a. See comment item no. 6 above. b. 2nd sentence: is this bulkhead door have an automatic closure device? Is one recommended/necessary?	Sectn. 4.6.2.10 revised
P. 4-32	11	Section 4.6.2.11: Please elaborate on this sentence: i.e. what kind of "centralized role" should FISC play in the Fire Protection Program? Their staffing is limited	Sectn. 4.6.2.11 revised

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B-13g

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DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
		and their fire fighting expertise is the same. The A-E should provide a concept (outline form, brief description) of FISC's role and interaction with the other players.	
P. 5-9	12	Section 5.4.4: Would it be possible to provide a sketch or map of the aquifers overlayed Red Hill? I believe this would have a greater impact than the narrative on the seriousness of the spill prevention problem.	SEE ATTACHED FIG. 5-4
P. 5-20	13	Section 5.5.4, 1st ¶: "if" should be "is". (typo).	WillBros will Correct
P. 5-22	14	Section 5.6.2, last ¶: "he" should be "the" (typo)	WillBros will Correct

Critical Infrastructure

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DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
Figure 5-3	15	Can this figure be improved - bad copy?	WillBros will make every effort to improve copy
P. 6-2	16	Section 6.3, 2nd ¶: Recommend Critical Infrastructure be shown on figure 3-2.	WillBros will indicate location of doors on figure 3-2
P. 6-11	17	Section 6.6.2.3.b. i. Recommend that this scenario and conclusion be reviewed. If figures 3-1 and 3-2 are correct, a catastrophic, large spill flowing down the LAT would first "follow the path of least resistance" straight down to Critical Infrastructure down the Harbor Tunnel. With hydrostatic heads of Critical Infrastructure (scenario one) the elevation of Critical Infrastructure there will be some fuel going "out the door".	SEE ATTACHED SHEET

WILLBROS ENGINEERS, INC.

JOB NO. ______ PREPARED BY: ______ DATE 6/15/98

CLIENT ______ CHECKED BY: ______ SHEET ______ OF ______

SUBJECT RESPONSE TO ITEM 17 PG 9 OF 14

WITH THE CASE 1 SCENARIO, FUEL FROM A Critical Infrastructure WITH A FULL TANK, FUEL FLOWING PAST Critical Infrastructure Critical Infrastructure IS SHOWN AS GOING Critical Infrastructure IN TABLE 4-5. AT THAT SLOW VELOCITY THE FUEL WILL NOT RUSH PAST Critical Infrastructure Critical Infrastructure BUT WILL INITIALLY FLOW DOWN BOTH THE HARBOR TUNNEL AND THE LAT AND WHEN THE FUEL REACHES THE Critical Infrastructure IT WILL SEEK ITS OWN LEVEL CAUSING ALL THE FLOW TO GO DOWN THE HARBOR TUNNEL.

WHEN THE FUEL REACHES EQUILIBRIUM THE CALCULATED HEAD AT Critical Infrastructure IS Critical Infrastructure OF LIQUID. THE FLOOR ELEV. AT THIS POINT Critical Infrastructure THEREFORE A COLUMN OF LIQUID WOULD RISE TO AN ELEV. OF Critical Infrastructure WHICH IS STILL INSUFFICIENT TO CAUSE FUEL TO FLOW OUT THE Critical Infrastructure ENTRANCE AT ELEV. Critical Infrastructure

THESE THEORETICAL CALCULATIONS ASSUME A LEAK-FREE TUNNEL, WHICH IT IS NOT, AND THEREFORE ACTUAL ELEVATIONS OF LIQUID LEVEL WOULD BE SOMEWHAT LESS THAN THE CALCULATED LEVELS.

FORM NO. 973-1013

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OTHER		OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
P.5-20	18	Section 5.5.4, Evaluation of Earthquake : The major concern of the Statement of Services (¶1.b.(1)) was the poor condition of the piping supports in the tunnel and their ability to retain the pipes during an earthquake. I'm not sure if there are restraints and sway braces existing, but wouldn't there be pipe movement and with poorly maintained supports, some possible damage with a spill potential? Welded steel fuel pipe has performed well on Guam during the recent earthquake, but the pipe often is knocked off of it's supports (aboveground piping).	SEE ATTACHED SHEET

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WILLBROS ENGINEERS, INC.

JOB NO. ____________ PREPARED BY: ____________ DATE 6/15/98

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CONCRETE ANCHORS Form a Substantial Support FOR The Piping in THE TUNNEL. The Critical Infrastructure pipe is close TO THE Floor AND Supported Vertically AND Laterally by CONCRETE SUPPORTS. SEE THE Attached DWG. Critical Infrastructure Piping Above Critical Infrastructure Pipe is Framed in by The STEEL Double Angle Support AND THE TUNNEL SHELL. Critical Infrastructure LINE Above Critical Infrastructure piping is THE MOST VulNERABLE TO AN EARTHQUAKE SINCE THE ONLY FORM OF Retention ON THE Support is a 3" x 3" x 1/4" Angle clip WELDED TO THE END of The Steel Angles. FURTHER Support of Critical Infrastructure LINE COULD BE by "U" clamping ON EVERY OTHER OR EVERY THIRD Support – (50'–75')

. WILLBROS HAS Revised SECTION 5.5.4 AND 5.6.2 TO INCLUDE ADDITIONAL SUPPORT FOR Critical Infrastructure Piping. See Attached Rewrite. CHANGES ARE Noted IN Script.

WITH RESPECT TO THE POOR CONDITION OF PIPE SUPPORTS WillBros RECOMMENDS CORRECTING THESE CONDITIONS RATHER THAN COMPENSATING FOR THEM.

FORM NO. 973-1013

Exposure to Contaminated Drinking Water

As discussed Section 5.5.3.2, fuel will likely leach to ground water. The potential human consumption of contaminated drinking water would provide the worst-case health risk for human exposure. Dermal contact with contaminated drinking water and inhalation of water vapor would also provide a health risk. In the event of a spill, the PWC pump station should be shut down immediately.

Exposure to Contaminated Soil

Human exposure to contaminated soil will be eliminated in Scenario Two.

Direct Contact with Fuel

Workers inside the Red Hill storage facility or tunnels at the time of the release could be severely impacted by the flowing fuel.

5.5.3.5 Scenario Two: Potential Impact to Flora and Fauna

Scenario Two would eliminate any impact on flora and fauna.

5.5.4 Evaluation of Potential for Earthquake Damage

The seismic zone for Oahu is 2A, according to the Uniform Building Code. For the maximum 475-year return period, the peak effective ground acceleration is 0.150 g.

Oahu has experienced a number of earthquakes in recent recorded times, although most that are felt on Oahu are centered near the island of Hawaii and cause no damage on Oahu. In the spring of 1948, an earthquake of 4.8 magnitude, centered slightly off the coast of Oahu, resulted in broken windows in downtown Honolulu (Macdonald et al., 1983). The 1948 earthquake had a seismic intensity of VI on the Modified-Mercalli Scale, and caused little other damage in Honolulu (Furamoto, 1990). In 1978 an earthquake of 4.2 magnitude was centered on the north shore of Oahu, again causing little or no damage on Oahu.

Earthquake damage to the interior of tunnels is rarely significant or irreparable, except in places which do not have good natural ground or are subject to eccentric loads (Okamoto, 1973). Damage may take the form of failure of portal sections, transverse and longitudinal cracking of the linings, spallings and deformation. Tunnels in hard rock will undergo significantly less earthquake damage than tunnels through soft rock. Liner thickness may have some effect on the magnitude of damage; where liner thicknesses vary in a tunnel, damage is often greater in sectors with thick lining (Okamoto, 1973).

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In the early 1950's an investigation was conducted by C.K. Wentworth concerning cracks in the lining of the Red Hill Tunnel system (Wentworth, 1954). He investigated conditions back of the gunite arch in some areas and found that the wood framing had rotted and was incapable of supporting any load. Wentworth found no evidence of crushing or of pressure or load from the rock above, which appeared to be holding its natural arch, despite an earthquake of considerable intensity in 1948.

Wentworth attributed the cracks in the gunite roof to tension cracks, due to the slumping of the gunite shell, which resulted from rotting wood supports. He suggests that this slumping may have been aggravated by earthquake disturbance, but it was his view that the tunnel cracks were cosmetic problem only and that there was no threat to the continued stability of the rock tunnel itself. Wentworth recommended patching the gunite but considered it not necessary to rebuild the tunnel lining with reference to supporting the overlying rock structure.

MFA believes that the potential for earthquake damage to the Red Hill tunnel is low, given the quality of the rock through which the tunnel passes. In the Red Hill end of the tunnel, the tunnel and tanks are constructed in primary basalt, and the likelihood of earthquake damage of the tunnel rock structure is very low. The tuff formations seaward of Red Hill consist of well-cemented basalt and calcareous ejecta, and, while not as hard as primary basalt, appear to be structurally competent. Sections of the tunnel may pass through an approximately 5-foot strata of weathered rock that forms the contact between the Alimanu and Salt Lake tuff deposits. Wentworth alluded to this weathered rock overlying the tunnel in the location of the cracks he investigated, but he also describes the apparent integrity of the rock arch in this area, despite the occurrence of a sizable earthquake since construction of the tunnel.

Piping in the tunnel is supported by anchors as shown in Figures 5-5 and 5-6 and by steel and concrete supports shown in Figure 5-7. **Critical Infrastructure** *is close to the floor and is supported vertically and laterally by concrete supports. The* Critical Infrastructure *above* Critical Infrastructure *is framed in by the steel double angle support and the tunnel shell.* **Critical Infrastructure** *above* Critical Infrastructure *is the most vulnerable to an earthquake, especially in areas midway between the anchors since the only form of retention on the support is the 3-inch x 3-inch x ¼-inch angle clip welded to the end of the horizontal steel angle supports. Restraining the movement of this line to prevent it jumping off the support or being pushed off the support by collapsing rock and tunnel lining during an earthquake would provide a low cost form of insurance. Restraint at every other support or* *every third support would prevent the line leaving the support; The greater number of restraints would lessen the load at any given support.*

5.6 Conclusions and Recommendations

5.6.1 Conclusions

In conclusion, an uncontrolled massive fuel release from the Red Hill tanks or LAT would cause irreparable damage to the drinking water source below the site. The cost of clean up would be prohibitive, long term, and may not be completely successful. The benefits of preventive measures to avoid a catastrophe, far outweigh the cost and environmental effect of a massive or even short term fuel release.

In Scenario One, drinking water is significantly impacted since fuel flows into the PWC pump station and all along the LAT and upper portion of the Harbor Tunnel. Surface water and surface soils are significantly impacted by releases from Critical Infrastructure the water riser shaft, and the former diesel power station. These areas of release also result in more human and environmental (flora and fauna) exposure. Since the Scenario One release is spread over such a large area and many media are effected (i.e., groundwater, surface water, and soil), the required cleanup effort and cost would be tremendous.

By comparison, in Scenario Two the release of fuel is contained in the tank area. No surface spill would occur and the potential for human contact with contaminated soil and surface water, as well as impact to flora and fauna would be eliminated or reduced. In addition, immediate action to remove the fuel from the LAT will reduce the potential of drinking water contamination substantially.

5.6.2 Recommendations

It is our recommendation that precautions be taken to protect the drinking water below the site. If a release of fuel was to occur it would be best to contain it before it flows down the LAT. If containment did not occur at the end of the tanks additional precautions should be taken to protect the PWC pump station. Water tight doors should be repaired, designed, and maintained, especially near the PWC pump station, to divert the fuel away from the water pumping station down the tunnel and into the **Critical Infrastructure** Critical Infrastructure and into Pearl Harbor. A surface spill in Pearl Harbor would be easier to clean up than a release into the subsurface and drinking water aquifer at Red Hill.

If a major spill occurs and is contained behind water-tight doors, provisions must be made to remove this fuel quickly. A pipe through the bulkhead that is valved on the downstream side of the door and can be tied into existing piping will allow drainage of the fuel into the existing fuel piping so pumps at the

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receiving pumphouse can pump this fuel into another Red Hill tank or transfer the fuel to the Upper Tank Farm or other storage. Such a bypass system exists Critical Infrastructure

Additional recommendations include:

- Seal the manhole cover of the well in the PWC pump station and install water tight doors before (upgradient) of the pump station.
- Install doors or thrust block to prevent a release from reaching the PWC pump station.
- *Install U-clamps 24 Critical Infrastructure in tunnel to restrain movement of this line in case of earthquake, per Figure 5-7.*
- Install a tank level monitoring system.
- Make hourly visual checks of the tanks, tunnels, and pipelines.
- Repair and routinely test the water-tight doors.
- Repair cracks and open holes in the tunnel.
- Seal off the two former drainage tunnels to Halawa Stream.
- Seal off the doorway to Critical Infrastructure
- Install secondary confinement thrust block below Critical Infrastructure
- Repair and clean out french drain in Harbor Tunnel.
- Clean out and test product in open trench near sump for tanks.
- Clean out drains beneath Harbor Tunnel.
- Seal the water riser shaft at Critical Infrastructure to prevent a release from reaching the surface.
- Emergency evacuation procedures for Critical Infrastructure and workers at Red Hill.

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- Floor drains in the Harbor Tunnel and Pump House should be periodically cleaned out to ensure they are working properly.

- The tunnel floor has many holes, some of which were formed by water damage and others man made. Efforts to seal the holes in the floor and walls should be undertaken as precautionary measures, but the possibility of sealing all holes in the floor and walls of the tunnel seems unlikely.

Critical Infrastructure

Figure 5-5
Red Hill Complex
Tunnel Piping Anchors

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Critical Infrastructure

Figure 5-6
Red Hill Complex
Tunnel Anchors
for Piping

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Critical Infrastructure

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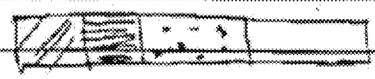
OTHER		OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
P. A1.2-4	19	Section A1.2.5.2: recommend that a table or diagram be provided showing the coring results, similar to a soils boring log; i.e.:  Exhibit D1-1 could also incorporate this information as an alternative.	WILLBROS HAS PREPARED A TABLE ON CORING RESULTS. EXHIBIT D1-1 HAS BEEN REVISED TO INCLUDE THIS INFORMATION. SEE COPY ATTACHED
P. A3.2-6	20	Section A3.2.9.7: Recommend that what the fire dept. does during drills be mentioned briefly. This may emphasize the futility on relying solely on the fire dept.	Sectn. 4.6.2.3 "Fire Department" has been revised
P.1, A4.1-?	21	Part A4.1, FSC Notes: highly recommend that much of the description of the existing	WILLBROS HAS RELOCATED THIS DESCRIPTION TO THE FRONT OF SECTION 6 REPLACING THE FIRST TWO PARAGRAPHS OF SECTION 6.3

PACDIV REVIEW COMMENTS
PH-PACDIV 10-11012/4 (Rev. 11-93)

PROJECT TITLE CONTRACT NO. N62742-89-C-0069 FIRE/RISK ASSESSMENT STUDY, RED HILL TUNNEL COMPLEX	DATE 28 Sep 94	PAGE 12 OF 14
	DD FORM 1391	DESIGN CRITERIA
	95% PRELIM. PLANS	FNL SPCS & PLNS

GOVERNMENT REVIEWERS	NAME/PHONE NO.	A-E	NAME/PHONE NO.
ARCHITECTURAL		ARCHITECTURAL	
STRUCTURAL		STRUCTURAL	
X MECHANICAL	ROY M. KANESHIRO (808) 474-5131	MECHANICAL	
ELECTRICAL		ELECTRICAL	
CIVIL		CIVIL	
FIRE PROTECTION		FIRE PROTECTION	
SPECS AND EST.		SPECS AND EST.	
OTHER		OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
		facility and conditions be relocated to the front, Section 6.	
P.2, A4.1-?	22	5th ¶:	
		a. Would a vestibule be recommended for the other Critical Infrastructure Critical Infrastructure ?	Yes - added to recommendation Sect. 4.?.2
		b. Could the area in the LAT behind the bulkhead at Critical Infrastructure be used as a vestibule or safe area in the event of a fire in the area of the lower tanks?	
		c. Would a mandoor thru the bulkhead on the LAT level be recommended?	Yes - has been recommended
P.4, A4.1-?	23	3rd ¶: recommend that these MOVs be indicated/shown on figures 3-1 & 3-2.	WILLBROS WILL INDICATE MOV'S ON FIGS 3-1 AND 3-2
P.11, A4.1-?	24	Last ¶: does the A-E have any recommendations for a fire plan	Added to recommendations Revised 4.6.2.2 & new Exhibit 4-5

PACDIV REVIEW COMMENTS
PH-PACDIV 10-11012/4 (Rev. 11-93)

PROJECT TITLE CONTRACT NO. N62742-89-C-0069 FIRE/RISK ASSESSMENT STUDY, RED HILL TUNNEL COMPLEX	DATE 28 Sep 94	PAGE 13 OF 14
	DD FORM 1391	DESIGN CRITERIA
	95% PRELIM. PLANS	FNL SPCS & PLNS

GOVERNMENT REVIEWERS	NAME/PHONE NO.	A-E	NAME/PHONE NO.
ARCHITECTURAL		ARCHITECTURAL	
STRUCTURAL		STRUCTURAL	
X MECHANICAL	ROY M. KANESHIRO (808) 474-5331	MECHANICAL	
ELECTRICAL		ELECTRICAL	
CIVIL		CIVIL	
FIRE PROTECTION		FIRE PROTECTION	
SPECS AND EST.		SPECS AND EST.	
OTHER		OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
		since the fire dept. does not have any?	
P. A5.1-1, P. A-7	25	Section A5.2.2.8: Should the H-1 Freeway grout pipes be checked and filled, if necessary? It appears that the elevation at this point may be Critical Infrastructure fuel under pressure could leak out thru the open pipes.	PIPES USED FOR GROUTING SHOULD BE FILLED. PIPES WERE ALSO CAPPED. Recommend PIPECAPS BE CHECKED AND REPLACED IF NECESSARY.
General	26	How is a pin hole leak in one of the fuel pipes in the Harbor Tunnel be fought? Would water be adequate for the interim until the fire dept. or the train with the AFFF arrives?	By use of recommended large capacity wheeled dry chemical extinguishers for [illegible] fighting of pressurized fuel [illegible].
General	27	The fire protection system for S-59, Underground Pumphouse,	See Sectn. 4.3.1.5.1 "Fire Alarm System

B-13g

RDHLCC0025000
BWS004701

PACDIV REVIEW COMMENTS
PH-PACDIV 10-11012/4 (Rev. 11-93)

DATE 28 Sep 94 | PAGE 14 OF 14

PROJECT TITLE CONTRACT NO. N62742-89-C-0069
FIRE/RISK ASSESSMENT STUDY, RED HILL TUNNEL COMPLEX

DD FORM 1391 | DESIGN CRITERIA
95% PRELIM. PLANS | FNL SPCS & PLNS

GOVERNMENT REVIEWERS	NAME/PHONE NO.	A-E	NAME/PHONE NO.
ARCHITECTURAL		ARCHITECTURAL	
STRUCTURAL		STRUCTURAL	
X MECHANICAL	ROY M. KANESHIRO	MECHANICAL	
ELECTRICAL	(808) 474-5331	ELECTRICAL	
CIVIL		CIVIL	
FIRE PROTECTION		FIRE PROTECTION	
SPECS AND EST.		SPECS AND EST.	
OTHER		OTHER	

DWG NO. OR SPEC PARA. NO.	ITEM NO.	COMMENTS	ACTION
		provided an annunciator system at the entrance to Critical Infrastructure to help the firemen to assess the condition and location of the fire when they arrive at the site. The thinking was that there will be thick black smoke in the tunnel and pumphouse and the annunciator will indicate where the fire was located. Would such a system be recommended for the proposed AFFF deluge system for the Critical Infrastructure?	Yes -
		The firemen would experience worse conditions in the Red Hill Complex than the pumphouse.	covered in Sectn. 4.3.1.5.5

TOTAL P.21

25

SECTION 4

FIRE AND LIFE SAFETY RISK ASSESSMENT/ANALYSIS

4.1 General

Firesafety Consultants was contracted by Wilbros Butler Engineers, Inc. to perform a fire and lifesafety risk assessment/analysis of the Red Hill Tank/Tunnel Complex. The primary objective of this study was to provide recommendations and alternative approaches for improving current conditions and/or correcting any deficiencies.

A field survey of the Red Hill Complex was conducted during the period May 2-11, 1994. The field survey team for fire protection consisted of John Echternacht, Firesafety Consultants, Kenneth Echternacht, Firesafety Consultants, and Terry Forehand, Wilbros Butler Engineers. Daily survey notes and photographs are included as Appendices to this report and provide a record of the field investigation.

This study includes an assessment of all areas of fire and life safety risk assessment/analysis outlined in the Scope of Work as defined in Section 2.0 of this report.

4.2 Codes, Regulations, and Standards

4.2.1 General

The purpose of this section is to identify the applicable codes, regulations, and standards used for conducting the risk assessment/analysis for the Red Hill Complex.

Such codes, regulations, and standards include local, state and federal government codes, nationally recognized codes and standards, industry practices, and applicable military standards. A listing of these codes, regulations, and standards is included in Section 4.2.2. Section 4.4 provides an evaluation of the facility and its components against the listed regulations and what is considered good engineering, maintenance and operating practice.

4.2.2 Applicable Codes, Regulations, and Standards

A general listing of the categories of codes, regulations, and standards is given below.

- Local Codes, Regulations, and Standards

- State Codes, Regulations, and Standards

– Federal codes, Regulations, and Standards

(Code of Federal Regulations [CFR])

– American Petroleum Institute (API)

– National Fire Protection Association (NFPA)

– National Electrical Code (NEC)

– Navy Manuals

4.2.2.2 Specific Codes Within Categories of Codes, Regulations, and Standards

Specific codes within the categories of codes, regulations, and standards specified in Section 4.2.2 are addressed below.

a. Local Codes, Regulations, and Standards

No specific local Honolulu city and county fire protection codes, regulations, or standards have been identified that pertain to USN facilities.

b. State Codes, Regulations, and Standards

No specific State of Hawaii fire protection codes, regulations, or standards have been identified that pertain to USN facilities.

c. Federal Codes, Regulations, and Standards (Code of Federal Regulations [CFR])

The Code of Federal Regulations (CFR) contains the federal codes, regulations, and standards which apply to DOD Bulk Fuel Storage Terminals. The CFR is divided into titles which are subdivided into chapter and parts. Titles and parts are abbreviated in this document for convenience. For example 29CFR1910 means Title 29 of the Code of the Federal Regulations, Part 1910. Fire protection and safety regulations which apply to the Navy facilities are given below.

1. Title 29 - Labor
Chapter XVII; Parts 1900 to 1910;
Occupational Safety and Health Administration, Labor
Part 1910.106 - Flammable and Combustible Liquids

d. American Petroleum Institute (API)

The American Petroleum Institute (API) presents categories which contain standards, recommended procedures, and publications which apply to petroleum facilities. The categories

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that apply to fire protection and safety are listed below.

1. Safety and Fire Protection

   - Publ. 2003, Protection Against Ignition Arising Out of Static, Lightning and Stray Currents
   - Publ. 2004, Inspection for Fire Protection
   - Publ. 2015, Cleaning Petroleum Storage Tanks
   - Publ. 2021, Guide for Fighting Fires In and Around Petroleum Terminals
   - Publ. 2350, Overfill Protection for Petroleum Storage Tanks

e. National Electrical Code (NEC), 1993

f. Underwriters Laboratories, Inc. (UL), 1994

g. Factory Mutual Research Corporation (FM)

h. National Fire Protection Association (NFPA)

   - NFPA 10, Portable Fire Extinguishers, 1990
   - NFPA 11, Low Expansion Foam and Combined Agent Systems, 1988
   - NFPA 12, Carbon Dioxide Extinguishing Systems, 1993
   - NFPA 12A, Halon 1301 Fire Extinguishing Systems, 1992
   - NFPA 13, Installation of Sprinkler Systems, 1991
   - NFPA 14, Installation of Standpipe and Hose Systems, 1993
   - NFPA 15, Water Spray Fixed Systems, 1990
   - NFPA 16, Installation of Deluge foam-Water Sprinkler Systems and Foam-Water Spray Systems, 1991
   - NFPA 20, Installation of Centrifugal fire Pumps, 1990
   - NFPA 22, Water Tanks for Private Fire Protection, 1993
   - NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances, 1987

- NFPA 30, Flammable and Combustible Liquids Code, 1990

- NFPA 37, Installation and Use of Stationary Combustion engines and Gas Turbines, 1990

- NFPA 70, National Electrical code, 1993

- NFPA 72, National Fire Alarm Code, 1990

- NFPA 91, Installation of Exhaust Systems for Air Conveying of Materials, 1992

- NFPA 101, Safety to Life from Fire in Buildings and Structures, 1994

- NFPA 101M, Alternative Approaches to Life Safety, 1988

- NFPA 329, Handling Underground Releases of Flammable and Combustible Liquids, 1992

i. Navy Manuals

- NAVFAC DM-22, Petroleum Fuel Facilities, August 1982

- NAVFAC MO-230, Maintenance and Operation of Petroleum Fuel Facilities, August 1990

- MIL-HDBK-1008b, Fire Protection for Facilities Engineering, Design and Construction, 15 JANUARY 1994

- MIL-HDBK-1022, PETROLEUM FUEL FACILITIES, 30 JUNE 1997

j. Other Codes, Regulations, and Standards

- Society of Fire Protection Engineers (SFPE) Handbook of Fire Protection Engineering, September 1988

- NFPA Fire Protection Handbook, 17th Edition

4.3 Fire, Life Safety, Electrical Risk Assessment

4.3.1 Fire Protection

4.3.1.1 General

Fire protection for the underground fuel storage and tunnel complex at Red Hill consists of water supplied from a 500,000 gallon concrete aboveground tank located Critical Infrastructure

Water supply to the upper access tunnel is provided through a new 6 inch line which is also routed through the ventilation shaft at the PWC water pump station to supply the lower access tunnel. The old 6 inch riser in the elevator shaft has been abandoned in place (installed a wedge-type plug valve to isolate riser from the supply).

The water supply for Red Hill is for manual fire fighting purposes only withy hydrants (valved outlets) located every 50 feet in the tank area and every 250 feet in the tunnel section. No hose stations or self-contained breathing apparatus are provided for Fuel Department personnel (see Section 4.6.2.5 for recommendations).

In the case of a major fire or other emergency condition, reliance is placed on response by the Federal Fire Department. Response time to a remote location in the underground facility could be as much as 30 minutes. It should be further noted that the fire department must bring their own hose packs, breathing equipment, and foam concentrate when responding to such an emergency situation.

Communications throughout the underground facility for operations and/or fire department personnel is totally lacking. The existing telephone system is not in service.

4.3.1.2 Red Hill Fuel Storage Area

There is currently no fixed fire protection installed in the underground fuel facility. The Cardox 22 ton low pressure carbon dioxide system that was installed in the early 1960's for protection of the upper and lower tunnel areas east of the bulkhead housing Critical Infrastructure has been taken out of service and abandoned in place. The storage tank is still located in [redacted] but has been emptied; all piping and nozzles are still in place. The existing heat detection system for this system is also not in service.

The only fire protection provided is by means of portable fire extinguishers and valved outlets for connection of fire hose by responding fire department personnel.. The fire protection water line in the upper and lower access tunnels is a 6 inch line.

4.3.1.3 Lower Access Tunnel Critical Infrastructure

The only fire protection for this area are portable fire extinguishers and valved outlets for fire hose as noted above.

4.3.1.4 Harbor Tunnel

At the Critical Infrastructure adjacent to the PWC water pump station there is a twin agent hose reel unit (500 lbs. Purple K dry chemical and 100 gallons of premixed AFFF). This unit is mounted on a rail car and is moved by rail to areas of temporary construction to provide standby manual fire fighting capabilities.

The entire length of the Harbor Tunnel is protected by a water line with valved outlets located approximately every 250 feet for connection of fire hose. Line sizes for the water supply vary from 6 inches from the **Critical Infrastructure** then a 20 inch line and next a 32 inch PWC potable water line for water supply.

4.3.1.5 Fire Protection Systems

This section reviews the characteristics and operating principles of the various types of fire suppression systems for consideration to protect the Red Hill Complex.

4.3.1.5.1 Aqueous Film Forming Foam (AFFF)

Aqueous film forming foam (AFFF) is obtained from synthetic fluorochemical surfactants. Foaming agents, stabilizers, and solvents are added to form the concentrate. AFFF is unique, because it allows a film of water to form on a hydrocarbon fuel surface. It extinguishes fire by suppressing fuel vapor due to the presence of the aqueous, or watery, film. AFFF comes in both 3% and 6% concentrations.

Actually AFFF has many mechanisms that work together to help extinguish a fire. They come from the aqueous film, the mechanical foam, and the water content. The aqueous film suppresses vapors, improves the spreading ability of the foam, and tends to reseal itself when distributed. The mechanical foam suppresses vapors, and separates the fuel from the air. The water content has a cooling effect.

AFFF is widely used in fighting hydrocarbon fires due to its swift control time.

4.3.1.5.2 Gaseous Systems

The two most widely used gaseous agents are carbon dioxide and Halon 1301.

a. Carbon Dioxide

Carbon dioxide is an inert, non-corrosive, electrically non-conductive extinguishing agent used on fires involving flammable liquids and fires involving electrically energized equipment.

Carbon dioxide is a gas under normal conditions of temperature and pressure, but is easily liquefied by compression and cooling. As the pressure increases, the density of the vapor over the liquid increases. On the other hand, the liquid expands as the temperature goes up and its density decreases. At 87.8 degrees F (31 degrees C) the liquid and vapor have the same density, and, of course, the liquid phase disappears. This is called the critical temperature for carbon dioxide. Below the critical temperature, carbon dioxide in a closed container is part liquid and part gas. Above the critical temperature it is entirely gas.

Carbon dioxide cannot exist as a liquid at pressures below 60 psig (75 psi absolute). This is the triple point pressure where carbon dioxide may be present as a solid, liquid or vapor. Below this pressure it must be either a solid or gas, depending on the temperature. This latter point is critical in system design. The pressure drop of agent flowing through piping is mainly due to increasing friction losses and partly due to the pressure in the pipeline is allowed to drop below 60 psig the liquid may convert to solid carbon dioxide (dry ice) and literally plug the pipe or discharge nozzles.

The relative density of carbon gas, when compared with dry air at 32 degrees F and atmospheric pressure, is 1.529. In other words, carbon dioxide is about 1 ½ times heavier than air.

Although carbon dioxide is only mildly toxic, it can produce unconsciousness and death when present in fire extinguishing concentrations (34 - 50% by volume in air). The personnel hazard is more related to suffocation or a reduction in the oxygen content. In concentrations above 9 percent most persons will lose consciousness within a few minutes. Breathing a higher concentration could render a person helpless almost immediately.

As a result of the above considerations, fixed-automatic systems utilizing carbon dioxide require that a time delay be incorporated into system design to allow sufficient time for personnel evacuation prior to release of agent.

Carbon dioxide is stored under pressure as a liquid, and, when released, is discharged into the fire area principally as a gas. As a guide, 1 pound of it may be considered as producing 8 cubic feet of free gas at atmospheric pressure. When released onto burning materials, it envelops them and dilutes the oxygen to a concentration which cannot support combustion.

Carbon dioxide is effective for extinguishment of Class A combustibles, Class B flammable liquids, and Class C energized electrical equipment. It is a "clean agent" in that it will not damage equipment or leave a residue. Some cooling effect is realized upon agent discharge, but you should not encounter "thermal shock' to equipment if the system is properly designed.

Carbon dioxide systems are classified according to the manner in which the agent is stored; either low pressure (bulk storage) or high pressure (individual cylinders).

A low pressure carbon dioxide system utilizes a large insulated and refrigerated storage tank. The carbon dioxide is maintained at 300 psi by keeping the temperature at approximately 0 degree F. Low pressure systems are normally provided when the quantity of agent required exceeds 2000 pounds

A high pressure system utilizes one or more cylinders manifolded together. The pressure at 70 degrees F is approximately 850 psi. Protection of hazards using flammable or combustible liquids requires a design concentration of 34% and hazards containing electrical equipment requires a design concentration of 50% by volume.

In accordance with NFPA Standard #12, a total flooding system requires that a minimum 30% design concentration be achieved within two minutes and the total design concentration be achieved within seven minutes.

The major disadvantage of using carbon dioxide in occupied areas is the hazard to personnel.

Since carbon dioxide is a suffocating agent, the requirement exists to evacuate the hazard area prior to system discharge. Such a delay allows added time for a fire to increase in magnitude and intensity.

A further consideration is that leakage or dissipation of agent into other occupied areas could create an additional life safety problem.

However, a properly designed system will take all of the above factors into consideration. Carbon dioxide is a clean agent, three dimensional, does not require drainage or clean-up, is relatively inexpensive, readily available, and is very effective for protection of enclosed hazard areas.

b. Halon 1301

Halon 1301 is an inert gas. It has a vapor pressure of 199 psig and a boiling point of minus 72 degrees F. although its vapor pressure would adequately expel the agent, it decreases rapidly with a temperature fall to 56 psig at 9 degrees F and 17.2 psig at -40 degrees F. therefore, in fixed piped systems, the agent container is super pressurized with nitrogen to 360 psig. Finally, the heat of vaporization of Halon 1301 is relatively low, which means that saturated liquid will immediately vaporize into a gas upon discharge.

A major advantage of Halon 1301 is its effectiveness as a fire suppression agent at very low concentrations. A 5% concentration of Halon will extinguish most flammable liquid fires and most Class A combustible incipient surface fires. Personnel can safely be exposed to design concentrations up to 7% for short periods of time without any harmful effects. Therefore, where personnel exposure exists, the utilization of Halon 1301 is further justified.

Although Halon 1301 does not represent a life safety concern, in recent years the fire protection industry has become aware of the potential depletion of the global ozone layer by chlorofluorocarbon (CVC) emissions; emissions which include the halon generated fire suppression agents. Thus, current use of the halon generated agents are on a restricted bases.

4.3.1.5.3 High Expansion Foam

High expansion foam concentrates are obtained from surfactants that do not contain fluorochemicals. As their name suggests, they possess expansion ratios ranging from 100:1 to 1000:1. Most other foam concentrates, are classified as low expansion foams with expansion ratios of approximately 10:1.

High expansion foam requires special application hardware. It is particularly suited as a flooding agent for control and/or extinguishment of Class A and Class B fires in confined spaces. The foam is an aggregation of bubbles mechanically generated by the passage of air or other gases through a net, screen, or other porous medium that is wetted by an aqueous solution of surface active foaming agent.

High expansion foam is a unique vehicle for transporting wet foam masses to inaccessible places, for total flooding of confined spaces and for volumetric displacement of vapor, heat, and smoke.

4.3.1.5.4 Other Feasible Alternatives

a. Water Deluge System

Water is without doubt the oldest fire extinguishant employed by man. It is a two dimensional extinguishant and is usually available in vast quantities.

A water deluge system consists of a system of pipes provided with open heads or nozzles that will distribute water onto the fire. A deluge system requires a separate detection system for automatic operation (as with all other systems described above).

Water suppression systems are effective for controlling flammable liquid fires, but for rapid flame knock-down and providing total extinguishment and system becomes much more effective when a foam concentrate is added.

b. Dry Chemical System

Dry chemical is primarily used in the hydrocarbon processing industry due to its recognition as an extremely efficient agent in extinguishing fires in flammable liquids.

Dry chemical possesses the ability to control fires by a rapid knock-down of the flame front. However, it will not provide securement of a flammable liquid spill or pool fire. Therefore, the agent must be properly applied to achieve total extinguishment.

Dry chemical is one of the most effective agents for extinguishment of three dimensional flammable liquid fires and gas pressure fires. Dry chemical has the further added advantage of concise experimental data to support the design criteria in this latter application.

Although total flooding dry chemical systems have been designed and installed the most effective use of the agent is based upon a local application technique. Therefore, this agent is better suited for protection of flammable liquid fires by using large capacity wheeled extinguisher units.

4.3.1.5.5 Fire Alarm System

As part of the field survey NAVFAC Specification Number 14-89-24-16 (construction contract no. N62471-89-C-2416) were reviewed. This contract is to provide a fire alarm system for the upper and lower access tunnel areas at Red Hill.

The scope of work includes providing a new intelligent addressable fire alarm system consisting of explosion proof heat detectors throughout the upper and lower access tunnel areas (25 foot maximum spacing), manual pull stations, fire alarm horns, and elevator recall for firefighters' emergency service. The system will fully annunciate to provide separate alarm and trouble lamps for each zone alarm initiating circuit. This will provide system annunciation for operating personnel and the fire department to properly access the condition and location of the fire.

It is recommended that the fire alarm system, as proposed, be utilized for automatic actuation of the AFFF systems to be provided for the lower access tunnel areas. The fixed pipe AFFF system will be designed to provide protection for the value galleries and tunnel areas for a pair of fuel storage tanks (1.3., Critical Infrastructure). This arrangement is compatible with the proposed zone arrangement for the fire alarm system: e.g., Fire alarm zone 28 is the heat detection zone for Critical Infrastructure Fire alarm zone 27 for Critical Infrastructure etc. For example, if a fire was detected in the valve galleries or adjacent Critical Infrastructure Critical Infrastructure FA zone 28 would be actuated and the AFFF system for Critical Infrastructure would be tripped. If the fire spread from one zone to the next, that respective FA zone would be actuated and the respective AFFF system would be tripped. Provisions will also be provided for manual actuation of each respective AFFF system.

4.3.2 Life Safety

Primary entry and exiting from the Red Hill complex are as follows:

Critical Infrastructure

There are Critical Infrastructure between the upper access and lower access tunnels: Critical Infrastructure Critical Infrastructure

Limited access to the upper tunnel is provided by [redacted] Also secondary egress from the harbor Tunnel is provided by a ladder in the ventilating shaft located at the wye intersection near the PWC water pump station. [redacted] is sealed and locked, thus not providing either entrance or egress from the Harbor Tunnel.

The life safety evaluation of the Red Hill complex has been based primarily on a review of Chapter 30 of NFPA 101, Life Safety Code. In accordance with Section 30-7.3 Underground Structures, an existing underground structure with an occupant load of 100 or fewer persons in the underground portions of the structure is exempt from the exiting requirements of NFPA 101.

However, due to the uniqueness of this facility, a combination underground structure, a mine (tunnel structure), and underground fuel tank, additional consideration should be given to emergency evacuation as follows:

- At the time of the survey the entrance to Critical Infrastructure was barricaded and padlocked. Provision should be made to be able to evacuate from

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this [redacted] during an emergency. It should also be available for egress of fire fighting personnel.

- The only means of egress from the Critical Infrastructure is the existing Critical Infrastructure A second means of egress should be provided for this area by installing a man-door in the existing bulkhead separating Critical Infrastructure and Critical Infrastructure Critical Infrastructure

- The Critical Infrastructure requires a vestibule (horizontal fire separation) at each tunnel level for the protection of workers while waiting for the elevator is case of fire or other emergency.

- Emergency lighting and exit signs shall be connected to the emergency power supply as discussed in sections 4.3.3.3 and 4.6.2.7.

- Although the occupancy level in the underground facility during normal operations is limited it is recognized that a higher occupant load may occur during special site visits or during future construction contracts. With implementation of the above three recommendations and administrative control to limit the occupancy to 100 or fewer persons, it is felt that the existing means of egress from this facility will be adequate. However, if more than 100 persons are required to be in this underground facility additional considerations from NFPA 101 must be applied.

- Prior to any site visit y non-operating personnel it is imperative that a briefing be given regarding the layout of the facility, means of egress, and emergency procedures.

As discussed in Section 4.3.1, due to the layout of this facility and the large quantity of fuel being stored, the potential for a fire emergency is large. Further, as discussed in Section 4.4, the life safety of FISC personnel due to a potential catastrophic release of fuel also presents a major concern. Therefore, in the event of a fire or fuel release in this underground facility it is imperative that personnel is notified immediately of such as emergency condition.

It is recommended that an early warning emergency voice/alarm communication system be installed throughout the underground facility. This system will replace the existing (out of service) telephone system. This system will provide 2 way emergency voice communication for operations and/or firefighter communications well as audible/visual alarm notification for emergency evacuation purposes.

4.3.3 Electrical

Sections 4.3.3.1 through 4.3.3.3 remain unchanged from the Draft Report.

4.3.4 Ventilation

The Red Hill complex being evaluated is located underground with practically no natural ventilation. Mechanical ventilation is provided by Critical Infrastructure Critical Infrastructure These units provide a good flow of air to all areas of the fuel storage and tunnel complex. Combined capacity of all fans is Critical Infrastructure

The ventilation systems are connected for automatic shutdown upon closure of the drop-track doors.

Provision should be made (if it doesn't currently exist) for the mechanical ventilation system to have manual override capability such that fire department personnel can restart the system under emergency conditions.

In addition, fire department personnel will respond to a fire emergency with portable smoke ejectors to be positioned in strategic areas as required.

Due to the configuration of this facility a smoke control system is not feasible or recommended.

4.4 Potential Catastrophic Failure

This entire Section remains unchanged from the Draft Report.

4.5 Cost Analysis

This entire Section remains unchanged from the Draft Report.

4.6 Conclusions and Recommendations

Sections 4.6.1 through 4.6.2.2 remain unchanged from the Draft Report.

4.6.2.3 Fire Department

Fire department personnel are familiar with the facility. They conduct an annual simulated fire drill. However, site interviews indicate that there are no prepared Pre-Fire Plans indicating response to different fire/emergency scenarios. Exhibit 405, attached, provides a suggested
4-5

format for the development of a Facility pre-Fire Plan.

The fire inspectors conduct monthly visual inspections of the fire equipment to assure that it is in place and appears to be functioning. They prepare a written report of their observations and any deficiencies which is turned over to the Fire Warden (Fuel Dept. Superintendent) to provide a more detailed follow on inspection and correct deficiencies.

On an annual basis the Federal Fire Department conducts a simulated fire drill. Their normal dispatch to the Red Hill complex consists of two engine companies and one ladder company; equipment comprises 2 - 1000 gpm pumper trucks and 1 - ladder truck. They also respond with hose packs, self-contained breathing apparatus, and other emergency equipment.

The fire Department maintains 6000 gallons of 3% AFFF concentrate and also has a form truck with 1000 gallons of AFFF.

Fire Department personnel consist of 100 persons on duty at all times.

4.6.2.4 Emergency voice/Alarm Communication

This Section remains unchanged from the Draft Report.

4.6.2.5 Manual Firefighting

The Fuel Department is relying too much on outside support from the fire department. In a fire emergency the Federal Fire Department must respond with all needed firefighting equipment; fire hose packs, foam concentrate, self contained breathing equipment, etc. The only equipment on-site are portable fire extinguishers and a emergency rail car located at the Critical Infrastructure Critical Infrastructure The rail car contains a twin agent hose reel system consisting of 500 lbs. Purple K dry chemical and 100 gallons of pre-mixed AFFF; the system is self-contained and pressurized by separate nitrogen cylinders. This rail car is used for emergency conditions as well as fire watch equipment support during cutting and welding operations.

The Red Hill complex requires the installation of fire hose stations, 150 lb. Purple K wheeled fire extinguishers, and dedicated self contained breathing apparatus for the usage of their own personnel.

Thirty six (36) fire hose stations shall be located at each existing valve outlet Critical Infrastructure Critical Infrastructure Each hose station shall consist of 100 feet of 1-1/2 inch fire hose. A minimum of 6 hose packs (each with 100 feet of 1-1/2 inch fire hose) shall be provided on the emergency rail car for manual firefighting response for a fire condition in the harbor tunnel.

Ten (10) 150 lb. Purple K dry chemical wheel extinguishers shall be provided for manual firefighting for fuel spills and/or pressurized fuel fire (e.g., pin hole leaks in fuel piping). See Exhibit 4-3 for equipment location.

It is also recommended that twelve dedicated self-contained breathing apparatus units be provided for FISC and/or Fire Department personnel. See exhibit 4-4 for location of these units.

4.6.2.6 Egress

Major projects by outside contractors consist of "hot work" (cutting and welding), dismantling piping, and cleaning of tanks. Contracts with outside contractors require that a competent contractor person be responsible for assuring safe conditions; perform inspections to assure gas free conditions.

Present operating procedures require that the Inspection Branch of the Federal Fire Department issue all "hot work" permits.

Outside personnel periodically tour the Red Hill complex (e.g., Navy League, POL conferees, and others). During such tours, these visitors enter the facility at Critical Infrastructure go through the heavy blast door at the upper tunnel, look into Critical Infrastructure currently out of service), then exit the facility. The visitors do not use the elevators nor do they go through any portion of the lower tunnel.

There is only one method of egress from the lower tank level in the new tank section; using the elevator. It is strongly recommended that a secondary method of egress be provided by installing a man-door in the lower bulkhead separating the 2 sections.

At present the entrance to Critical Infrastructure s barricaded and padlocked. Provision should be made to be able to evacuate from this adit during an emergency. It should also be available for egress of fire fighting personnel.

Emergency lighting and exit signs shall be connected to the emergency power supply as discussed in Sections 4.3.3.3 and 4.6.2.7. Emergency illumination shall meet the performance requirements of NFPA 101, Section 5-9.

During normal operations the occupancy level is very limited (less than 20 persons). However, it is recognized that a higher occupant load may occur during special site visits or during future construction contracts. With implementation of the above three recommendations and administrative control to limit the occupancy to 100 or fewer persons, it is felt that the existing means of egress from this facility will be adequate. Furthermore, a site briefing should be given to all non-operating personnel regarding the layout of the facility, means of egress, and emergency procedures prior to entering the Red Hill complex.

As noted in Section 4.6.2.5, self contained breathing equipment should be provided to allow personnel in the complex breathable air during the evacuation period. Dedicated units should be provided in the gauger station, Receiving Pumphouse control room, and Critical Infrastructure

Sections 4.6.2.7 through 4.6.2.9 remain unchanged from the Draft Report.

4.6.2.10 Ventilation

The ventilation system will need further review to assure adequate ventilation for the lower tank storage is provided when an additional bulkhead separation is provided between the tank area and the main tunnel. However, the door in this bulkhead will normally be open (and provided with an automatic closure device), as is the case with the existing doors so the ventilation will only be marginally affected.

4.6.2.11 Overall Fire Protection Program

The Fire Protection Program appears to be very fragmented. There is currently multiple areas of responsibility as noted:

Inspection	-	Federal Fire Department Fuel Department, Fire Warden
Maintenance	-	PWC
Engineering	-	PACDIV PWC Fuel Department
Firefighting	-	Fuel Department Federal Fire Department

The Fuel Department (FISC) needs to take a centralized role in the Fire Protection program for the Red Hill complex. Various parts of the program can be delegated to other departments as noted above (e.g. maintenance to PWC), but the overall responsibility for the Fire Protection program must reside with a single entity-the Fuel Department.

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APPENDIX B-1

SITE INVESTIGATIONS PHOTOGRAPHS

Photograph Number	Description
RH3-100	Exterior entrance to [redacted] 5/94
RH3-101	Exterior entrance to [redacted] - 5/94
RH3-102	Exterior entrance to [redacted] - 5/94
RH3-103	[redacted] entrance to lower access tunnel - 5/94
RH3-104	Above ground 500,000 gallon water storage tank - 5/94
RH3-105	Abandoned 22 ton low pressure carbon dioxide storage tank [redacted] 5/94
RH3-106	Twin-agent fire fighting rail car located at Y-intersection at underground water pump station - 5/94
RH3-107	Twin-agent storage tanks on rail car; 500 lbs. Purple K dry chemical and 100 gal. Pre-mixed AFFF - 5/94
RH3-108	Valved outlet for fire hose station, lower access tunnel at fuel tanks - 5/94
RH3-109	Valved outlet for fire hose station, Harbor Tunnel - 5/94
RH3-110	New 6 inch water line located in ventilating shaft, looking up from Harbor Tunnel - 5/94
RH3-111	New 6 inch water line exiting base of ventilating shaft at Harbor Tunnel level - 5/94

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RH3-112 Y-intersection Critical Infrastructure
Critical Infrastructure Note - fuel lines on left, 6 inch water line top center of photo - 5/97

RH3-113 6 inch Clayton reducing valve on 6 inch water line, lower access tunnel - 6/94

RH3-114 Typical steel supports for fuel lines in Harbor Tunnel Critical Infrastructure
Critical Infrastructure 5/94

RH3-115 Rail locomotive and steel support for fuel lines - 5/94

RH3-116 Typical valve gallery at base of fuel tank, lower access tunnel - 5/94

RH3-117 Typical valve gallery on opposite side of lower access tunnel - 5/94

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AFFF FIRE SUPPRESSION SYSTEM

Due to the quantity of fuel stored in the Red Hill complex and the potential for a fuel release in the lower tunnel, it is recommended that a fixed aqueous film forming foam (AFFF) fire suppression system be installed to provide protection for this area.

It is proposed that Critical Infrastructure 600 gallon 3% AFFF bladder tank pressure proportioning systems be provided to supply foam solution to zoned open head deluge systems. The systems will be automatically actuated by rate compensation thermal detectors (to be provided under construction contract no. N62471-89-C-02416; Provide Fire Alarm System for Red Hill POL Fuel Storage Facilities). detection/deluge zones are recommended as follows:

Critical Infrastructure

The design density for the AFFF system will be Critical Infrastructure of floor area. Total AFFF concentrate required for each system will be based upon the following calculations:

Area of coverage for each system:

Critical Infrastructure

Water supply to each AFFF system will be fed by the existing 6 inch water line located in the lower access tunnel. Each system will consist of a 600 gallon 3% AFFF bladder tank with required trim, 4 inch OS&Y valve, 4 inch deluge valve (connected to fire alarm system for automatic actuation), 4 inch foam proportioner, distribution piping, and open head sprinkler nozzles.

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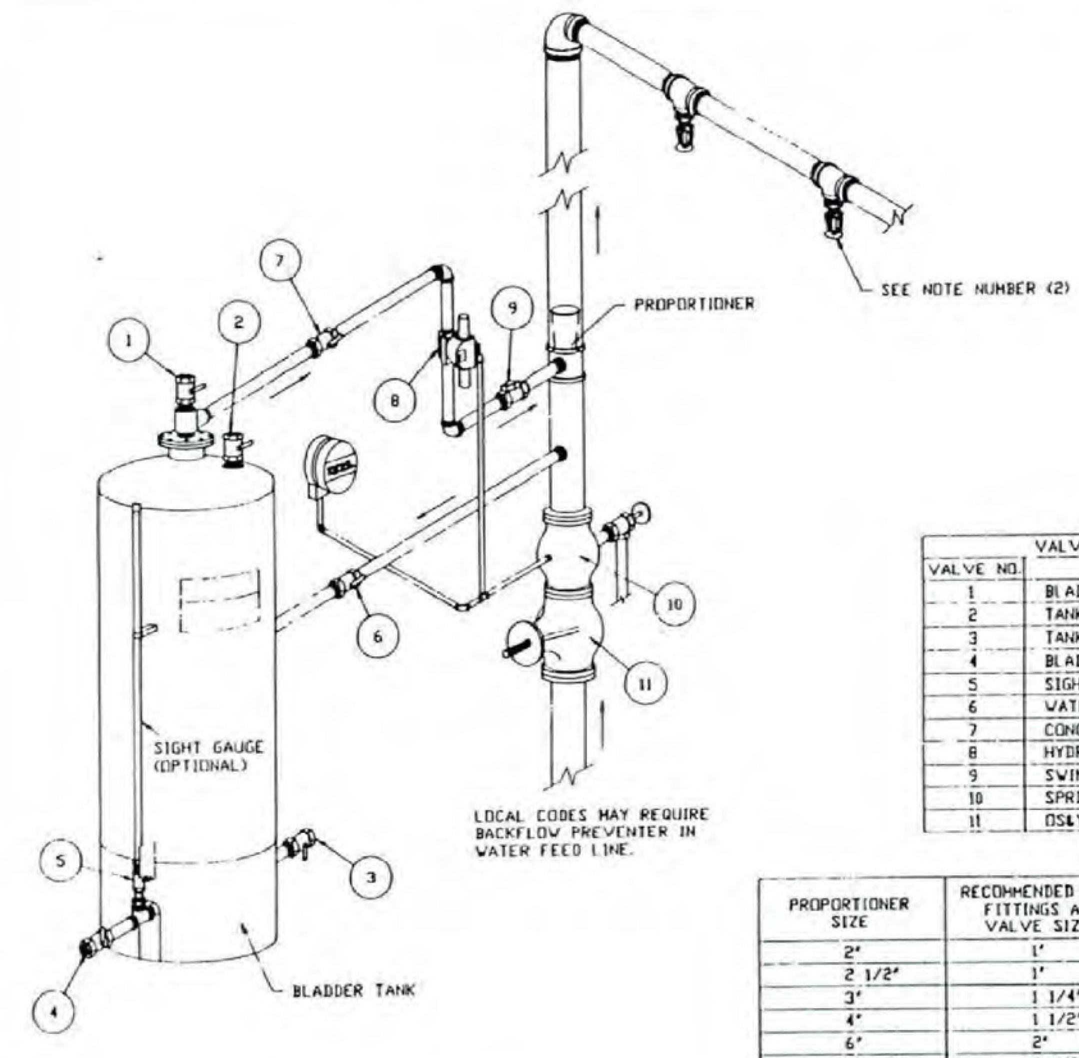

NOTES:

1. SPRINKLER VALVE MAY BE ALARM CHECK, DRY PIPE, PRE-ACTION, OR DELUGE TYPES AS REQUIRED BY SYSTEM DESIGN.

2. DISCHARGE DEVICE MAY BE SPRINKLER HEADS (AS SHOWN) OR OTHER TYPE DEVICE SUCH AS MONITOR NOZZLES, HANDLINE NOZZLES, OR FOAM CHAMBERS AS REQUIRED BY SYSTEM DESIGN.

3. ARROWS INDICATE DIRECTION OF FLOW.

4. RECOMMENDED INTERCONNECTING PIPE, FITTINGS, AND VALVE (SEE CHART, NUMBERS 6 THRU 9) SIZES TO BLADDER TANK ARE GIVEN CORRESPONDING TO PROPORTIONER SIZE.

5. PIPE, VALVES, AND FITTINGS MAY HAVE TO BE UPSIZED TO ENSURE NEAR 0 psi FRICTION LOSS TO MAINTAIN BALANCED PRESSURE OF WATER AND CONCENTRATE AT THE PROPORTIONER.

6. THE HYDRAULIC CONCENTRATE VALVE (VALVE #8) MAY BE ELIMINATED ON AN AUTOMATIC SYSTEM HAVING ONE PROPORTIONER PROVIDED THE PROPORTIONER IS LOCATED AT AN ELEVATION AT OR ABOVE THE BLADDER TANK FOAM CONCENTRATE OUTLET CONNECTION LOCATED AT THE TOP OF THE TANK.

VALVE DESCRIPTION		NORMAL POSITION	
VALVE NO.	DESCRIPTION	MANUAL SYSTEM	AUTO SYSTEM
1	BLADDER VENT/FILL - 1"	CLOSED	CLOSED
2	TANK SHELL VENT - 1"	CLOSED	CLOSED
3	TANK SHELL DRAIN - 1"	CLOSED	CLOSED
4	BLADDER DRAIN/FILL - 1"	CLOSED	CLOSED
5	SIGHT GAUGE (OPTIONAL) - 1/2"	CLOSED	CLOSED
6	WATER INLET	OPEN	OPEN
7	CONCENTRATE SUPPLY	CLOSED	OPEN
8	HYDRAULIC CONCENTRATE	---	CLOSED
9	SWING CHECK	---	---
10	SPRINKLER ACTUATION/ALARM	---	CLOSED OR OPEN
11	OS&Y	CLOSED	OPEN

PROPORTIONER SIZE	RECOMMENDED PIPE FITTINGS AND VALVE SIZES
2"	1"
2 1/2"	1"
3"	1 1/4"
4"	1 1/2"
6"	2"
8"	2 1/2"

TYPICAL BLADDER TANK SYSTEM
PIPING REQUIREMENTS

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Foam Fire Fighting Systems Specifications

Bladder Tank Proportioning System

1.0 The Foam Solution:

The foam solution shall be produced by introducing foam concentrate into the water stream by the balanced pressure proportioning method using a bladder (diaphragm) pressure tank and a modified venturi proportioner (ratio controller).

1.1 Bladder Tank:

Tank shall be a (vertical) ~~(horizontal)~~ cylindrical steel ASME coded pressure vessel with a nylon reinforced Buna-N bladder shaped to conform to the inner pressure vessel configuration. Tank shall be designed for working pressure of 175 psi (1207 kPa) and hydrostatically tested to at least 262 psi (1806 kPa). The tank interior shall be coated with a coal tar epoxy sealer for additional corrosion resistance. The bladder tank shall be UL listed or FM approved together with the type of foam concentrate and proportioner(s) being used in the system. The bladder tank is to have a minimum 600 gallon capacity to provide sufficient foam concentrate for the time specified when the system is discharging foam solution at total maximum system flow. The bladder tank is to be complete with all necessary outlets and supports such as a continuous welded skirt equal to tank diameter or two saddle supports as appropriate. Associated trim on the bladder tank shall include bronze pipe and fittings, four 1 in. bronze ball valves with secured nameplate depicting the valve name and operating position, and a break-resistant polycarbonate sight gauge. The tank exterior shall be primed and painted red ~~(enamel)~~ (epoxy) for corrosion protection. The bladder tank, proportioner, and foam concentrate shall all be the products of a single manufacturer. The bladder tank shall be an Ansul Part No. 69010 or equal.

1.2 Proportioner (Ratio Controller):

The foam proportioner(s) is to be a modified venturi type designed to accurately proportion and control the mixing of pressurized foam concentrate into a water stream. The proportioner shall have ~~either NPT threads (2 in. and 2 1/2 in. sizes) or~~ "between flange" type (~~3 in.~~, 4 in., ~~6 in. and 8~~ in. sizes) designed to fit between two 150 lb. pipe flanges. Proportioner(s) shall be sized for the specified flow rate(s) and either be UL listed or FM approved with the type of foam concentrate and bladder tank being used together in the system. A fixed metering orifice, secured with a stainless steel retaining ring, shall be sized according to the type and percentage of foam concentrate used. The proportioner(s) shall be an Ansul Part No. 69341 or equal.

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EMERGENCY VOICE/ALARM COMMUNICATION SYSTEM

As discussed in Sections 4.0 and 5.0 of this report the lifesafety of FISC personnel working in the Red Hill fuel complex is a major concern. Therefore, in the event of a fire or fuel release in this underground facility it is imperative that personnel be notified immediately of such an emergency condition.

It is recommended that an early warning emergency voice/alarm communication system be installed throughout the underground facility. This system will replace the existing (out of service) telephone system. It is proposed that a GAI-Tronics Model #271 hazardous area (intrinsically safe) telephone/fireman's telephone system with battery backup be installed. Ten (10) permanently installed telephone sets be located at strategic locations throughout the underground facility. The central panel for the fireman's telephone system will be located in the Receiving Pumphouse.

This system will provide 2-way emergency voice communication for operations and/or firefighter communications well as audible/visual alarm notification for emergency evacuation purposes . The system will be designed for a Class I, Division location.

150 LB. WHEELED DRY CHEMICAL FIRE EXTINGUISHERS

It is recommended that ten (10) Ansul 150 lb. Purple K (potassium bicarbonate) dry chemical wheeled fire extinguishers be provided in the underground fuel complex at the following locations:

Critical Infrastructure

TOTAL - 10 UNITS

SELF-CONTAINED BREATHING UNITS

There previously were self-contained breathing units located throughout the underground fuel facility at Red Hill. However, some time ago these units were removed at the instruction of the Environmental Safety Group.

Due to the delay in response time to the facility by personnel from the Federal Fire Department, it is critical that FISC personnel have the availability of self-contained breathing apparatus to assist in a safe evacuation of the facility in the event of an emergency condition.

It is recommended that twelve (12) minimum 30 minute capacity self-contained breathing units be provided in the underground fuel complex at the following locations:

Critical Infrastructure

<u>TOTAL - 12 UNITS</u>

EXHIBIT 4-5
SUGGESTED FORMAT FOR DEVELOPMENT OF A
FACILITY PRE-FIRE PLAN

..ilding No.: 105-KE, 1713-KD & 1714-KE — Master Box No.: 1250 & 1310 Street Box

A Platoon — Area 100-K — Date January 1992

MC Entered — Contractor WHC — Th. ... F ... Yr. 1993

Occupancy: Reactor Facility (deactivated)

Special Hazards: PCB oil, 4160V, Radiation and contamination, Argon cylinders. Plutonium fuel storage in basin.

Exposures: 1713-KE, 1714-KE, 119-KE, 117-KE, 1706-KER, 1706-KE, 1706-KEL, & 115-KE

Special Exposures:

Equipment Response: Engine #1 and Engine #2

Location of Electrical Disconnect: See floor plan (radiation zone) electrical equipment room.

Nearest Hydrant: #6 southeast, #7 east, and #8 northwest

Water Available: 3,000 GPM

Type of Automatic Alarm Systems: 12 Fenwal Heat detectors and wet sprinkler system - flow switch

Type Sprinkler Systems: SR 4" Wet pipe in corridor 1, flow switch, OS&Y valve and Auxiliary drains

COMPOSITION OF FACILITY

Critical Infrastructure

PLAN OF ATTACK

Engine #1 will respond to RFAR box #1250 and will use two 1 pre-connects for attack.

Engine #2 will respond and assist as needed and will also cover exposures.

NOTE: If a power outage occurs, all fire suppression water is lost, including hydrants.

[signature] 3-15-?

..ilding Management Representative

[signature] 3-14-45

Fire Department Officer's Concurrence

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1. ENTRY

Critical Infrastructure

2. ELECTRICAL SERVICE & HAZARDS:
Electrical equipment room 4160 V service. PCB-OIL - radiation zone - high voltage electrical shock. Entry to the electrical equipment room is by passing through basin storage area (radiation zone).

3. RADIATION - CONTAMINATION:
ZONE 1 on floor plan (RED). Storage basin, transfer area, miscellaneous storage area, wash pit, wash pad, storage area. Electrical equipment room and part of Room 3 off of Corridor 1.

Radiation and contamination signs are posted throughout the building from the basement area to the roof area.

4. TOXIC GASES - HAZARDOUS CHEMICALS:
Smoke and fumes from burning rubber and contaminated SWP clothing. PCB oil in electrical equipment Room. See information on back of this prefire plan.

5. PROTECTIVE CLOTHING:
Firefighters bunker gear, self-contained breathing apparatus. SWP clothing may be required to enter basin area.

6. RESCUE:
Rescue should be no problem in the nonradioactive or contamination areas. Basin area may create somewhat of a problem around the loadout area (radiation zone).

7. EXTINGUISHMENT:
Water, foam, dry chemical, CO2. (Approved fire extinguisher)

8. COMBUSTIBLES:
Class "A" -
Ordinary combustibles (wood, rubber, cloth paper, etc.)

Class "B" -
Flammable or combustible liquids (gases, grease or similar materials)

Class "C" -
Energized electrical equipment.

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9. VENTILATION:
Exhaust fans from fire apparatus.
Cross ventilation (open doors)
Building exhaust system

10. SALVAGE OPERATIONS:
Normal firefighting salvage operations in areas that are not contaminated or in radiation zones.

RMU, Safety and Building Manager should be present during salvage and overhaul operations.

11. FIRE DETECTION AND PROTECTION EQUIPMENT:
One wet sprinkler Jr. system. 4" w/OSY valve, flow switch that activates alarm system. Sprinkler system is located in Corridor 1 overhead.

One inspector test valve located in storage room (Room 1A) in the northeast corner.

Three auxiliary drains: One in Room 3, one in Corridor 1 and one in corridor 10

Six auxiliary boxes -
Three located on west wall in basin area by loadout area (radiation zone)

Two located on north side of 105-KE outside area.

One located on wall just inside main door leading to Corridor 1

Twelve Fenwal Heat Detectors (self restoring)
Five in deactivated control room
Three in electrical equipment room (radiation zone)
Three in 1714-KE Building (Heat detector)
Four in 1713-KE Smoke Detector

12. HEATING AND VENTILATION:
Overhead space heaters (wall mounted thermostat). There are five roof ventilators.

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13. ANNUNCIATOR AND/OR FIRE ZONES:
<u>NO ANNUNCIATOR PANEL - only one zone</u>

One sprinkler system flow switch; six auxiliary boxes and twelve fenwal heat detectors that will activate RFAR Box 1250. All will need to be checked to determine which caused the activation of RFAR Box 1250.

1. Box 1310 is a Street Box only

2. There is no panel

3. There are four smoke heads in building 1713-KE and 1714-KE.

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Critical Infrastructure

115KE

117KE

53

Critical Infrastructure

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Critical Infrastructure

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COST ESTIMATE WORKSHEET
PACDIV FM 4-4330/14 (1-86)

SHEET 1 OF 1

AREA	ACTIVITY	LOCATION	CONTRACT NO.
Red Hill Complex	Fire Protection	Pearl Harbor, HI	N 62742-89-C-0069
			AMENDMENT NO. 3

PROJECT TITLE: Fire / Lifesafety Risk Assessment / Analysis
Red Hill Fuel Facility

ITEM (OR FEATURE) DESCRIPTION (Abbreviate if necessary)	QUANTITIES: NO. OF UNITS	QUANTITIES: UNIT	MATERIAL COSTS: UNIT COST	MATERIAL COSTS: COST	LABOR COST: UNIT COST	LABOR COST: COST	ENGINEERING ESTIMATE: UNIT COST	ENGINEERING ESTIMATE: COST
1	2	3	4	5	6	7	8	9
1. AFFF Suppression System (Lower Access Tunnel)	1		—	$400,000	—	$250,000	—	$650,000
2. Emergency Voice/Alarm Communication System	1		—	$150,000	—	$100,000	—	$250,000
3. Ansul 150 lb. Purple K Wheeled Fire Extinguishers	10		$2,200	$22,000	—	—	$2,200	$22,000
4. Install Man-Door Opening Lower Access Tunnel	1		—	*	—	$15,000	—	$15,000
5. Self-Contained Breathing Apparatus	12		$500	$6,000	—	—	—	$6,000
6. Fire Hose Stations	36		$300	$10,800	—	—	$300	$10,800
Fire Hose Packs	6		$150	$900	—	—	$150	$900

PREPARED BY (Name)	APPROVED BY	TITLE OF ORGANIZATION	DATE
John Echternacht	JE	Firesafety Consultants	6/5/98

* Install existing submarine hatch bulkhead door

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DEPARTMENT OF THE NAVY

PACIFIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
(MAKALAPA, HI)
PEARL HARBOR, HAWAII 96860-7300

RECEIVED
OCT 14 1994
WILLBROS BUTLER
ENGINEERS, INC.

FACSIMILE TRANSMITTAL

FROM: ROY KANESHIRO CODE 403 DATE: 14 Oct 1994 TIME:______

TELEPHONE NO. (808) 474-5331 RETURN FAX NO. (808) 471-5870

COMMENTS:

1. Subject: AMENDMENT NO. 3, FIRE/RISK ASSESSMENT STUDY, RED HILL
2. Enclosures: DFR PAC review comments.
3. Attached are the review comments from DFR PAC for the subject study.
4. I will mail the originals to you as soon as I accumulate enough of them. Meanwhile, I'll fax them to you as I receive them.

To: ALLEN SMITH

COMMAND/COMPANY: WILBROS BUTLER ENGINEERS, INC.

CITY, STATE, ZIP CODE, COUNTRY: TULSA, OKLAHOMA

SENT TO FAX NO.: (918) 491-9436

TELEPHONE NO.: (918) 496-0400

NUMBER OF PAGES, INCLUDING THIS SHEET: 2

58

TO: ROY KANESHIRO, CODE 403
FAX: (808) 471-5170
PHONE: (808) 474-5331

FROM: DAVID ACFALLE
DEFENSE FUEL REGION - PACIFIC
BOX 64110
CAMP H.M. SMITH HI 96861-4110
FAX: 808 Critical Infrastructure 7-5710/DSN 477-5710
PH: 808 7-2641/DSN 477-2641

DATE: 13 OCT 1994
PAGES : 1

SUBJ: CONTRACT N62742-89-C-0069, RED HILL COMPLEX FIRE LIFE SAFETY AND ENVIRONMENTAL RISK ASSESSMENT STUDY; PRE-FINAL 95% SUBMITTAL

	ACTION AGENCY
1. Reference PACDIVNAVFACENGCOM ltr 1100 Ser 403/6311 of 23 Sept, subject as above. 2. In response to reference the following comments are provided. A. DFSC special project FY93 RED HILL PIPELINE MOISTURE SHIELDS is in place and funded to install permanent moisture shields over the entire pipeline system within the tunnel. This was not address in the study. The AE recommended plugging the gunite walls, is this the preferred method of keeping ground water off the pipes? Should FISC Pearl defer or cancel the moisture shield project?	SEE ITEM(1) ON ATTACHED SHEET.
B. The AE recommended a new oil tight bulkhead door be installed near tanks 1 and 2 to protect the rest of the tunnel in case of tank or pipeline failure. This proposal did not address how approximately 250M barrels of oil trapped behind the door will be recovered if such an event took place.	SEE ITEM(2) ON ATTACHED SHEET
C. An OSHA project is in place to install a fire alarm system with supervisory control of the tunnel elevators, doors and fans in the event of a fire. Again, this project was not taken into account when the study was done. Is the new system ad Critical Infrastructure te? How does this project impact the system they recommend be installed?	SEE ITEM(3) ON ATTACHED SHEET
D. DFSC special project FY94 EC INSTALL EMERGENCY GENERATOR RED HILL is funded to install an emergency gener Critical Infrastructure t Red Hill. The study recommends one be installed. Does the existing project address the AE conce E. Overall the study is very genera specially, when it comes to recommended solutions.	SEE ITEM (4) ON ATTACHED SHEET

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WILLBROS ENGINEERS, INC.

JOB NO. ______ PREPARED BY: ______ DATE 6/15/98

CLIENT ______ CHECKED BY: ______ SHEET ____ OF ____

SUBJECT RESPONSES TO DFR PAC Comments 13oct 1994

ITEM (1) - 2A Plugging of GUNITE WALLS is ONE METHOD of REDUCING INFILTRATION AND KEEPING WATER OFF PIPING AND STRUCTURAL STEEL. SHIELDING OR CONDUCTING THE WATER AWAY FROM PIPING AND STEEL USING PLASTIC PIPES WERE TWO OTHER METHODS SUGGESTED IN THE OPTIMIZATION AND MODERNIZATION STUDY, AMEND. 5 of NOV, 1994. See Section 8.1.3d AND SKETCH FIGURE 8.1.3.2 opposite PAGE 8.5. THE PROJECT TO PROTECT THE PIPES FROM MOISTURE (WHICH IS CAUSING CORROSION) SHOULD NOT BE DEFERRED. PAGE 6-14 STATES THE PROTECTION OF THE PIPELINES FROM IN-LEAKAGE WAS RECOMMENDED IN PREVIOUS REPORTS.

" (2) - 2B AS IN THE CASE OF "OIL TIGHT" Critical Infrastructure THERE IS A VALVED PIPE BY-PASS WHICH ALLOWS OIL TRAPPED BEHIND THE DOOR TO COME THROUGH THE BULKHEAD AND BE DIRECTED INTO FUEL LINES ON THE DRY SIDE OF THE BULKHEAD. THIS FUEL CAN THEN BE DIRECTED TO THE PUMPHOUSE FOR PUMPING BACK TO RED HILL OR THE FUEL CAN BE DIRECTED TO THE UPPER TANK FARM. See PARA 5.6.2 PAGE 5-21 AND 5-22 OF THE 95% SUBMITTAL.

" (3) 2C ADDRESSED IN NEW SECTION 4.3.15.5

" (4) 2D WILLBROS HAS EIGHT RECOMMENDATIONS IN PARAGRAPH 4.6.2.5 PAGE 4-29 TO IMPROVE THE EMERGENCY POWER SUPPLY AT RED HILL ONE OF WHICH INCLUDES INSTALLATION OF AN EMERGENCY GENERATOR.

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FORM NO. 973-1013

61

DEPARTMENT OF THE NAVY
PACIFIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
(MAKALAPA, HI)
PEARL HARBOR, HAWAII 96860-7300

FACSIMILE TRANSMITTAL

FROM: ROY KANESHIRO CODE 403 DATE: 21 Dec 1995

TELEPHONE NO. (808) 474-5131 RETURN FAX NO. (808) 471-5870

To: ALLEN SMITH

COMMAND/COMPANY: WILLBROS BUTLER ENGINEERS, INC.

CITY, STATE, ZIP CODE, COUNTRY: TULSA, OKLAHOMA

SENT TO FAX NO.: (918) 491-9436

TELEPHONE NO.: (918) 496-0400

NUMBER OF PAGES, INCLUDING THIS SHEET: 1

RECEIVED
DEC 21 1995
WILLBROS BUTLER
ENGINEERS, INC.

COMMENTS:

1. Subject: AMENDMENT NO. 3, FIRE/SAFETY RISK ASSESSMENT STUDY AND AMENDMENT NO. 6D, MCBH PIPELINE REPLACEMENT

2. I spoke to Brian Kim yesterday about giving Jim Gammon (and FISC Pearl) an ultimatum/deadline of around the 8 Jan 96. Brian felt that we should not try to finish up the study without Jim's input and suggested that we, PACDIV, have a joint, informal, review here in our office with Jim and Joe Conlin, PACDIV Code 408, sometime around mid-January 1996. I've revised my letter to FISC Pearl to request this review here at PACDIV and I'll keep you informed of our progress.

3. Brian also read the report and had the following review comments:

a. Vol. 1, Section 1, page 1-11, para. 1.7.4.2.h., 4th para.: Delete last sentence, "The relocation could never be justified or funded." Brian feels that this opinion does not expressed here since the A-E is not in a position to judge funding in DOD. Perhaps this could be reworded in another way that is not as strong or explicit (maybe change the words "could never be" to "would be difficult to"?).

Willbros will Delete Sentence.

b. Vol. 1, Section 1, page 1-11, para. 1.7.4.2.h, 5th para., first sentence: How would the fire hazard increase with underground piping? Is this a typographical error? Please explain or clarify since this is not obvious a face value.

See Item Response on PACDIV M. Hirano Comments 5/22/98

4. Please call me if you have any questions.

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20 MAY 1998
PAGE 1 OF 3

NAVAL FACILITIES ENGINEERING COMMAND
PACIFIC DIVISION
FAX

TO: ALLEN SMITH
WILLBROS ENGINEERS, INC
PHONE: (918) 499-2776
FAX: (918) 491-9436

FROM: MALCOLM HIRANO
CODE 403
PHONE: (808) 474-4830
FAX: (808) 471-5870

SUBJ: CONSTRUCTION CONTRACT N62742-89-C-0089, FIRE, LIFE SAFETY, AND ENVIRONMENTAL RISK ASSESSMENT/ANALYSIS FOR RED HILL TUNNEL COMPLEX

1. Attached are my comments and FISC's comments.

2. Mike Gladson is now the point of contact for FISC concerning this project. He is also the point of contact for the Railroad Track Study.

3. A concern that FISC has is that a lot of time has passed since this report was submitted. A validation of the conclusions, recommendations, and requirements should be updated in the report.

4. Give me a call and we can discuss what needs to be done for the final submittal.

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5-20-98 ;12:13PM ; CONTHIRD-NCB- 9184919406;# 2/ 3

COMPACNAVFACENGCOM REVIEW COMMENTS Malcolm Hirano, Code 400, Ph. (808) 474-4830	DATE: 5/20/98		PAGE 1 OF 1	
PROJECT TITLE		DD FORM 1391		DESIGN CRITERIA
Fire, Life Safety and Environmental Risk Assessment/Analysis	X	35% Report		FINAL PLANS / SPECS.
ACTIVITY	REVIEWERS			
FISC, Pearl Harbor		ARCHITECTURAL		CIVIL
		STRUCTURAL		COST & SPECS.
LOCATION	X	MECHANICAL		
RED HILL COMPLEX		ELECTRICAL		

DRAWING NO. or SPEC. SEC. NO	ITEM NO	COMMENTS	ACTION
Page 1-11, Second to last paragraph	1	"The relocation could never be justified or funded". This is too strong a statement. Delete sentence.	WillBros will Delete Sentence
Page 1-11, Last paragraph	2	Paragraph states that the hazards of fire would be increased if the tunnel pipelines were replaced with underground lines? How would the fire hazard be increased?	See Item (1) Below
Page 4-10, Paragraph 4.3.3.2.1	3	Consider tunnel to be "adequately ventilated", therefore classification should be Class 1, Division 2.	See Rewritten Electrical Section
General	4	Include compliance with MIL-HDBK-1022.	WillBros will Include.

Critical Infrastructure

-1998 16:10 808 4224721 P.02

MAY-26-98 TUE 12:20 9184992798 P.04

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FISC PEARL REVIEW COMMENTS

DATE March 31, 98	Page 1 Of 1

PROJECT TITLE Red Hill complex Fire, Life Safety and Environmental Risk Assessment/ Analysis	
ACTIVITY Fleet and Industrial Supply Center, Pearl Harbor	
LOCATION RED HILL POL STORAGE FACILITY	

SPEC PARA NO.	ITEM NO.	COMMENTS	ACTION	
1.7.2.2. d	1	A contract to provide communication for the Red Hill Facility is being prepared for solicitation		See Item (1) Below
1.7.2.2. f, g, & j	2	PACDIV has active design for the following projects: Ventilation for the Red Hill Complex, Electrical Dist. for the complex, and installation of the emergency exit through the bulkhead that separates the new from the old section.		See Item (2) Below
1.7.2.2. g	3	Construction funds have been requested a Emergency Generator that will provide power to the new section of the Red Hill Complex		See Item (3) Below
1.7.22.2, i 1.7.2, i	4	A fixed suppression system should be installed? Is this a requirement or recommendation? Cite code requirement. Need strong documentation why this system should be installed?		This is a recommendation based upon sound engineering judgement
1.7.2.2. k	5	Knowing that manpower is shrinking and only two personnel working at the Red Hill Facility, what can we do? The manpower will probably not increase, what can we expect ~~us~~ them to do?		See Note Below. (4)
		Because of the time that has passed since this submission, validation of the conclusions and requirements must be updated.		See revised Sectn. 4.6.2.11

(1) WillBros will ADD A STATEMENT "IT is understood A CONTRACT TO PROVIDE COMMUNICATION FOR THE RED HILL FACILITY is BEING PREPARED FOR SOLICITATION.

(2) WillBros will ADD STATEMENTS TO ITEMS 1.7.2.2 f, g & j CITING THE ACTION TAKEN ON THESE SUBJECTS.

(3) WillBros will ADD STATEMENT TO ITEM 1.7.2.2 g CITING ACTION TAKEN ON THIS SUBJECT.

(4) THIS COMMENT is NOT DIRECTED AT THE MAN POWER IN THE TUNNEL BUT MANAGEMENT'S ROLE IN FIRE PROTECTION. SINCE FISC HAS THE ULTIMATE RESPONSIBILITY FOR THE RED HILL FACILITIES IT FOLLOWS THAT FISC HAS THE ULTIMATE RESPONSIBILITY TO CORRECT THE ITEMS "a" THROUGH "j" IN SECTION 1.7.2.2 WHICH HAVE A BEARING ON FIRE PROTECTION.

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OPTIONAL FORM 99 (7-90)

50253 - 200

FAX TRANSMITTAL # of pages ▸ 4

To ALLEN SMITH	From M. HIRANO
Dept./Agency WILLBROS	Phone #
Fax # 918-491-9436	Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

RECEIVED
JUN 4 1998
WILLBROS ENGINEERS, INC.

MEMORANDUM

June 2, 1998

From: Joe Condlin, Code 408
To: Malcolm Hirano, Code 403

Subj.: **RED HILL ELECTRICAL CLASSIFICATION**

Ref.: (a) Willsbros Butler Engineers, Inc Study of Red Hill dated 9/94
(b) NFPA No. 30 - 1996, Flammable and Combustible Liquid Code
(c) NFPA No. 70 - 1996, National Electric code (NEC)
(d) MIL-HDBK-1022, Petroleum Fuel Facilities

1. The term "adequately ventilated" appears in most of the codes or standards relating to hazardous electrical classifications. Request Code 404 to provide substantiating calculations indicating where adequate ventilation exists through out the Red Hill Tunnel Complex.

2. Per your request reference (a) paragraph 4.3.3 from pages 4-7 thru 4-11 has been reviewed and the following technical comments are provided:

a. Paragraph 4.3.3.2 of reference (a) classifies DFM and JP-5 as Class IIIA combustible liquids. The most hazardous condition would be encountered by a release of fuel in an atomized state via a pinhole leak under high pressure. Concur based on paragraph 1-7.3.2 of reference (b).

b. Paragraph 4.3.3.2.1 of reference (a) indicates Red Hill **Lower Tank Tunnel** **Critical Infrastructure** and the ends of the lower access tunnel by Critical Infrastructure Critical Infrastructure is well ventilated with the exception of the valve gallery of each tank. Additionally there are fuel leaks during normal operation; there is an open sampling area; there is a waste trough in the floor with water, oil and sediments. Consequently, reference (a) recommends the following electrical classifications:

(1) Each valve gallery at each tank as a Class I, Division 2 location from the valve body down to the floor and from the tank face to the entrance of the main tunnel.

(2) The floor waste trench (trough) running the entire length of the lower access tunnel as a Class I, Division 1 location due to the trenching being below grade.

(3) The area adjacent to the floor trench will be Class I, Division 2 for 18 inches above ground and ten feet in all directions.

(4) Reference (b) under paragraph 5-9.5.1 indicates electrical hazardous classification applies to areas where Class I liquids are stored or handled, and to areas where Class I or Class II liquids are stored or handled at or above their flash points. At the present time these conditions do not apply to Red Hill. However, the release of a

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combustible liquid through a pinhole leak under high pressure is always a possibility in Red Hill. Therefore, Table 5-9.5.3 of reference (b) and Table 515-2 of reference (c) should be used to establish the electrical hazardous classifications.

(a) Under the category entitled "Indoor Equipment" or "Pumps, Bleeders, Withdrawal Fittings, Meters, and Similar Devices" each valve gallery at each tank is considered as a Class I, Division 2 location from the valve body extending 5 ft. in all directions; and up to 3 ft. above floor or grade level within 25 ft. horizontally from the edge of any valve.

(b) Under the category entitled "Pits With Adequate Ventilation" the floor waste trench (trough) running the entire length of the lower access tunnel as a Class I, Division 2 location for the entire space within the trench due to the trenching being below grade.

(c) Additionally, the space up to 18 inches above grade within 15 ft. horizontally from any edge of the floor trough shall be considered a Class I, Division 2 area per the category entitled "Drainage Ditches, Separators, Impounding Basin".

(5) Paragraphs 2.10.1.1 and 2.10.1.2 of reference (d) for adequately ventilated spaces requires an electrical hazardous classification of Class I, Division 2 within 5 ft of the surface of pumps, air relief valves, withdrawal fittings, meters, valves, screwed fittings, flanges, and similar devices extending 25 ft. horizontally from any surface of the devices and upward 3 ft above grade.

(a) Each valve gallery at each tank would be considered as a Class I, Division 2 location from the valve body extending 5 ft. in all directions; and up to 3 ft. above floor or grade level within 25 ft. horizontally from the edge of any valve.

(b) The floor waste trench (trough) running the entire length of the lower access tunnel is not specifically addressed in reference (d) so reference (b) and (c) apply, i.e., Class I, Division 2 location for the entire space within the trench due to the trenching being below grade.

(c) Additionally, the space up to 18 inches above grade within 15 ft. horizontally from any edge of the floor trough shall be considered a Class I, Division 2 area per references (b) and (c).

c. Paragraph 4.3.3.2.2 of reference (a) indicates the Red Hill Harbor Tunnel begins at the door from the Receiving Pumphouse to the sump area adjacent to Critical Infrastructure The Harbor Tunnel contains Critical Infrastructure Critical Infrastructure mounted along the east side of the tunnel. The tunnel is ventilated. Consequently, reference (a) recommends the following electrical classifications:

(1) The Harbor Tunnel is classified as a Class I, Division 2 location from floor to two feet above the floor.

(2) The valve areas at the Critical Infrastructure at the intersection at PWC water pump station, and Critical Infrastructure is considered a Class I, Division 2 area for three feet in all directions around the valves down to the floor.

(3) The remainder of the tunnel (i.e., outside of the above noted areas) is considered a nonclassified area.

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(4) Reference (b) under paragraph 5-9.5.1 indicates electrical hazardous classification applies to areas where Class I liquids are stored or handled, and to areas where Class I or Class II liquids are stored or handled at or above their flash points. At the present time these conditions do not apply to Red Hill. However, the release of a combustible liquid through a pinhole leak under high pressure is always a possibility in Red Hill. Therefore, Table 5-9.5.3 of reference (b) and Table 515-2 of reference (c) should be used to establish the electrical hazardous classifications.

(a) Under the category entitled "Indoor Equipment" or "Pumps, Bleeders, Withdrawal Fittings, Meters, and Similar Devices" the Harbor Tunnel is classified as a Class I, Division 2 location from the valve body, flanges, etc. extending 5 ft. in all directions and up to 3 ft. above floor or grade level within 25 ft. horizontally from the edge of any valve or flange.

(b) Under the category entitled "Indoor Equipment" or "Pumps, Bleeders, Withdrawal Fittings, Meters, and Similar Devices" the valve areas (at the Critical Infrastructure Critical Infrastructure at the intersection at PWC water pump station, and below the Critical Infrastructure are considered a Class I, Division 2 location from the valve body or flanges extending 5 ft. in all directions; and up to 3 ft. above floor or grade level within 25 ft. horizontally from the edge of any valve.

(c) The remainder of the Harbor Tunnel is considered a nonclassified area.

(5) Paragraphs 2.10.1.1 and 2.10.1.2 of reference (d) for adequately ventilated spaces requires an electrical hazardous classification of Class I, Division 2 within 5 ft of the surface of pumps, air relief valves, withdrawal fittings, meters, valves, screwed fittings, flanges, and similar devices extending 25 ft. horizontally from any surface of the devices and upward 3 ft above grade.

(a) Consequently, the entire Harbor Tunnel (5) is considered Class I, Division 2 within 5 ft of the surface of pumps, air relief valves, withdrawal fittings, meters, valves, screwed fittings, flanges, and similar devices extending 25 ft. horizontally from any surface of the devices and upward 3 ft above grade.

(b) The valve areas at the Critical Infrastructure at the intersection at PWC water pump station, and below the Critical Infrastructure is considered a Class I, Division 2 area within 5 ft of the surface of pumps, air relief valves, withdrawal fittings, meters, valves, screwed fittings, flanges, and similar devices extending 25 ft. horizontally from any surface of the devices and upward 3 ft above grade.

(c) The remainder of the Harbor Tunnel is considered a nonclassified area.

3. In summary Code 408 finds the hazardous electrical classifications to be as follows:

a. In the Red Hill Lower Tunnel:

(1) Each valve gallery at each tank is considered as a Class I, Division 2 location from the valve body extending 5 ft. in all directions; and up to 3 ft. above floor or grade level within 25 ft. horizontally from the edge of any valve.

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(2) The floor waste trench (trough) running the entire length of the lower access tunnel as a Class I, Division 2 location for the entire space within the trench due to the trenching being below grade.

(3) The space up to 18 inches above grade within 15 ft. horizontally from any edge of the floor trough shall be considered a Class I, Division 2 area.

b. In the Red Hill Harbor Tunnel:

(1) Class I, Division 2 within 5 ft of the surface of pumps, air relief valves, withdrawal fittings, meters, valves, screwed fittings, flanges, and similar devices extending 25 ft. horizontally from any surface of the devices and upward 3 ft above grade.

(2) Class I, Division 2 location from the valve body or flanges extending 5 ft. in all directions; and up to 3 ft. above floor or grade level within 25 ft. horizontally from the edge of any valve.

(3) The remainder of the Harbor Tunnel is considered a nonclassified area.

4. All of Code 408's analysis is based on having adequate ventilation, i.e., ventilation capable of keeping any vapor-air mixture below 25% of the fuel(s) lower flammability level. Code 403 is to provide a memo documenting their analysis regarding this critical point.

Joe Condlin

Joe Condlin

Copy to:
404
408
04A

Willbros Response:

We have revised Section 4.3.3 to respond to these comments. See revised Section 4.3.3 attached. Changes Noted in Script.

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TOTAL P.04

event of a fire or fuel release in this underground facility it is imperative that personnel be notified immediately of such an emergency condition.

It is recommended that an early warning emergency voice/alarm communication system be installed throughout the underground facility. This system will replace the existing (out of service) telephone system. This system will provide 2-way emergency voice communication for operations and/or firefighter communications well as audible/visual alarm notification for emergency evacuation purposes .

4.3.3 Electrical

4.3.3.1 General

The lower tank area electrical system originates in the PWC water pump station. There are two different electrical systems within the lower tank area; one system installed during the original construction and the other installed during the modification of Critical Infrastructure o proposed Avgas service.

4.3.3.1.1 PWC Water Pump Station

The PWC water pump station electrical distribution system is used to operate the water pump station electrical system and to provide electrical power to the lower tank area.

The incoming electrical system to the PWC water pump station originates from a single 12,000V source located Critical Infrastructure

The 12,000V is transformed to 480V and 208V. From the 480V and 208V system a feed is taken to a junction box "A" which is located outside of the PWC water pump station adjacent to Critical Infrastructure Critical Infrastructure From junction box "A" the 480V and 208V is taken underground to junction box "B" located in the lower access tunnel (lower tank area). From this point, the 480V and 208V are in separate conduits and run to the panels located outside of the gauger's station.

4.3.3.1.2 Lower Access Tunnel (Original System)

The lower access tunnel electrical system is the original electrical feed for Critical Infrastructure Critical Infrastructure which connects this area with the upper access tunnel.

The electrical feed originates Critical Infrastructure The 480V and 208V circuits connect to their respective breaker panels across from the gauger station. These two feeds are in separate conduits that are located in the tunnel and were installed during original construction.

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The 208V system feeds the following areas and devices:

a. Critical Infrastructure lights and receptacles

b. Critical Infrastructure lights and receptacles

c. Critical Infrastructure lights and receptacles

d. Critical Infrastructure lighting

The electrical feed for the Critical Infrastructure lights and upper access tunnel lights and receptacles is thru the Critical Infrastructure

The solenoid which operates the bulkhead door is connected to the Harbor Tunnel lighting circuit.

The 480V system feeds the following areas:

a. Breaker panel between Critical Infrastructure

b. Welding receptacles next to the above breaker panel.

c. Welding receptacles in the Critical Infrastructure

d. Critical Infrastructure

The 480V system in the tank area and the Harbor tunnel is fed from one circuit breaker in the 480V lighting panel Critical Infrastructure

4.3.3.1.3 Lower Tunnel Area Additions

The following items were added to the electrical system when the Asteroid system was installed:

a. Motor operators added to the valves to Critical Infrastructure at the Critical Infrastructure at Critical Infrastructure The electrical feed for the motor operated valves are tapped from the 480V circuit in Critical Infrastructure

b. Motor operators added to Critical Infrastructure adjacent to Critical Infrastructure and next to the original Critical Infrastructure The electrical feed is from a junction box located adjacent to the sump area. This junction box is original construction, and is installed to terminate the incoming and outgoing 480V and 208V conduits and cables. In addition, the power for the sump pumps is tapped from this junction box.

c. Motor operators added to Critical Infrastructure between Critical Infrastructure Critical Infrastructure

4.3.3.1.4 Lower Access Tunnel, Critical Infrastructure

These electrical modifications were made when Critical Infrastructure were revamped for Avgas use in the early 1960's. The incoming power is 12,000V from the PWC water pump station. The 12,000V is transformed down to 2400 V and 480V.

The 2400V circuit operates the motor/pumps and the 480V is to power motor operated valves, elevators and other miscellaneous equipment. A portion of the 480V is transformed to 208V for lighting and receptacles in the upper and lower tunnel areas. The conduit and wire from the electrical equipment to the tank area is run through the bulkhead.

4.3.3.1.5 Lower Access Tunnel Critical Infrastructure Additions)

A breaker was added to the 480V system to provide power to Critical Infrastructure The wire and conduit is installed in Critical Infrastructure

4.3.3.2 Electrical Classification

Both the diesel marine fuel (DFM) and the JP-5 have flashpoints of 140°F (60°C) and Reid vapor pressures of 0 psi. As such they classify as Class IIIA combustibles liquids. The possibility of an ignition of DFM or JP-5 by electrical equipment is considered to be remote. With such liquids the rate of vapor release is considered to be nil at normal temperatures of handling and storage. When heated, these liquids will release more vapors and thereby slightly increase the level of hazard. However, the most hazardous condition would be encountered by a release of this fuel in an atomized state (due to pinhole type release under high pressure conditions).

4.3.3.2.1 Fuel Tank Area

Red Hill lower tank level for this section starts with the Critical Infrastructure and ends at the end of the lower access tunnel by Tanks 19 and 20.

The area is ventilated with the exception of Critical Infrastructure This area contains Critical Infrastructure several manual valves, sample table, tank water bleed off and waste trough. The waste trough in the floor is full of sediment and other unknown solids. The water bleed off for each tank is in piping located in the water trough. It should be noted that there are fuel leaks during normal operation, there is an open fuel sampling area, and there is a lack of ventilation.

Therefore, each Critical Infrastructure *is considered a Class 1, Division 2 location from the valve body extending 5 feet in all directions and up to 3 feet above the floor within 25 feet horizontally from the edge of any valve.*

The floor trench that runs the length of the lower access tunnel will be classified as a Class I, Division ~~1~~ 2 location. This is due to the trench being below grade. The area adjacent to the floor trench will be Class I, Division 2 for 18" above ground and *fifteen (15)* feet in all directions.

The sump pump area will be classified as follows:

- *The part of the sump located belowgrade will be Class 1, Division 1.*
- *The part of the sump located abovegrade will be Class 1, Division 2 within 5 feet of the surface of the pumping facilities, extending 25 feet horizontally from any surface of the facilities and upward 3 feet abovegrade.*

Equipment in the sump area is installed for a Class I location, except for the telephone set which is not explosion proof.

4.3.3.2.2 Harbor Tunnel

The Harbor Tunnel (for purposes of this classification section) begins at Critical Infrastructure Critical Infrastructure

The Harbor Tunnel contains lighting, receptacles, distribution centers for lighting, telephone communications, and the circuit for the Critical Infrastructure The tunnel also contains Critical Infrastructure Critical Infrastructure The pipelines are welded, and valves are located at the Receiving Pumphouse, at Critical Infrastructure at

Critical Infrastructure and below the Critical Infrastructure The fuel pipelines are Critical Infrastructure Critical Infrastructure in concrete saddles and the Critical Infrastructure supported by steel supports.

The tunnel also serves as a corridor for a 32 inch PWC water line and a narrow gauge railroad. The railroad provides transportation between the Red Hill storage and the Receiving Pumphouse.

The tunnel is ventilated so there is a movement of air; there were no fuel odors noted at the time of the field survey.

The lighting and communications systems are in a deteriorated condition due to age, lack of available spare parts, and very little maintenance performed on the systems.

The tunnel will be classified as a Class I, Division 2 location from the floor to two feet above the floor. The remainder of the tunnel will be a nonclassified area. The valve areas Critical Infrastructure Critical Infrastructure will be classified as *follows:*

Class 1, Division 2 within 5 feet of the surface of pumps, air relief valves, withdrawal fittings, meters, valves, screwed fittings, flanges and similar devices extending 25 feet horizontally from any surface devices andupward 3 feet abovegrade.

Class 1, Division 2 location from the valve body or flanges extending 5 feet in all directions and up to 3 feet above floor or grade level within 25 feet horizontally from the edge of any valve.

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NAVAL FACILITIES ENGINEERING COMMAND PACIFIC DIVISION FAX

TO: ALLEN SMITH
WILLBROS ENGINEERS, INC
PHONE: (918) 499-2776
FAX: (918) 491-9436

FROM: MALCOLM HIRANO
CODE 403
PHONE: (808) 474-4830
FAX: (808) 471-5870

SUBJ: AE CONTRACT N62742-89-C-0069, AMENDMENT3, RED HILL FIRE, LIFE SAFETY & ENVIRONMENTAL RISK ASSESSMENT STUDY

1. FISC, Code 408, DER-PAC, and Code 403 has reviewed the preliminary responses of WEI to the 95% review comments.

2. FISC's only comment is the requirement for the AFFF system. Is there a code/standard requirement or is the recommendation based upon the engineering judgement of a qualified Fire Protection Engineer? This is needed for justification when FISC submits the request to fund this project. I do not believe that there is a code/standard requirement for the AFFF system. If based upon engineering judgement, the explanation must be strong enough to convince the people who will approve the funding for such a project. Provide write-up in report. FISC will most likely attach the applicable sections from this report to their funding request.

3. Code 408 concerns are attached. These were previously forwarded via e-mail.

4. DER-PAC and Code 403 have no comments to your responses at this time.

5. Proceed to the final report once Code 408 concerns and FISC concerns are addressed.

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To: Malcolm Hirano@CODE 04
From: Bob Riola@CODE 04@NAVFAC EFDPAC
Cc: Joe Condlin@CODE 04
Subject: RED HILL FIRE LIFE SAFETY & ENVIRONMENTAL RISK ASSESSMENT STDY
Attachment: BEYOND.RTF
Date: 7/14/98 8:31 AM

Reviewed the draft AE responces to the 95% report comments. Comments follow:

1. Fire & Life Safety Risk Assessment/Analysis: Provide the publication "month/year" of each specific code listed under paragraph 4.2.2.2. For instance the listed NFPA Fire Protection Handbook, 17th Edition, is outdated by an 18th edition. Also, it is not certain whether the A-E used MIL-HDBK-1008a, -1008b or -1008c; etc.

2. Code 408's comments: Not all of Code 408's comments of memo 4 Jun 1998 nor email of 6/10/98 were followed. Provide rationale. For instance, Code 408 calls for the trench to be Class I, Division 2, whereas it is shown as Class I, Division 1; etc.

VR/ Bob

WILLBROS RESPONSE TO ITEM 2: BASED ON ADEQUATE VENTILATION WE WILL USE CLASS I DIVISION 2 FOR TRENCH.
AWS

Firesafety Consultants response to Item 1 is as follows:

Revise the first paragraph of Section 4.2.2.2 to read as follows:

"Specific codes within the categories of codes, regulations, and standards specified in Section 4.2.2 are addressed below. It should be noted that the most current edition (at the time of the initial study) of the codes, regulations, and standards were utilized in performing this Fire and Life Safety Risk Assessment/Analysis."

Comments

The addition of the second sentence is recommended in lieu of having to go back and make sure that the specific month and/or year is correct for insertion after each specific document. This would be extremely difficult to re-create after such a lapse of time and guarantee accuracy. Further, the reviewer made reference to the fact that the NFPA Fire Protection Handbook, 17th Edition that was referenced in our study has been updated by the 18th edition. The 18th edition was published February 1997, well beyond the time when the report was prepared. Our engineering evaluation was based upon the use of the codes, regulations, and standards that were existing at the time of the study. The same comment applies to MIL-HDBK-1008; the current edition at the time of the study was utilized.

WILLBROS WILL ADD DATES WHERE POSSIBLE (AT THE TIME OF THE INITIAL STUDY) TO THE CODES AND REGULATIONS.

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(CFISC)

Firesafety Consultants response to Item 2 is as follows:

Revise the following sections to indicate a stronger requirement for the installation of a fixed aqueous film forming foam (AFFF) system for protection of the fuel storage area.

1.7.2.2 Recommendations

). Fire Suppression

There is no fixed fire suppression system in the tank storage area. A fixed suppression system (zoned AFFF deluge system) should be installed for protection of the lower tank storage area. AFFF is the recommended agent of choice for use in suppressing hydrocarbon fires due to its swift control time. This system will reduce potential damage to the facility, reduce potential environmental concerns, and improve the overall life safety concerns.

4.3.1.2 Red Hill Fuel Storage Area

The underground fuel storage facility consists of Critical Infrastructure storage tanks containing Diesel Fuel Marine (DFM) and JP-5 fuels as described in Section 3.1. The most likely fire scenario for this area is the release and subsequent ignition of unconfined combustible liquids resulting from a damaged tank valve or ruptured piping in the tank gallery area.

There is currently no fixed fire protection installed in the underground fuel facility. The Cardox 22 ton low pressure carbon dioxide system that was installed in the early 1960's for protection of the upper and lower tunnel areas east of the bulkhead housing Critical Infrastructure has been taken out of service and abandoned in place. The storage tank is still located in but has been emptied; all piping and nozzles are still in place. The existing heat detection system for this system is also not in service.

The only fire protection provided is by means of portable fire extinguishers and valved outlets for connection of fire hose by responding fire department personnel.. The fire protection water line in the upper and lower access tunnels is a 6 inch line.

Without a fixed fire protection system installed in this area a fire could cause massive damage to the facility and present major life safety concerns. Smoke and heat conditions would make egress extremely difficult and the possibility of a manual interior fire fighting attack by the Federal Fire Department would be virtually impossible. It is for these reasons that an automatic AFFF system should be installed in this area.

AFFF is the recommended agent of choice for use in suppressing hydrocarbon fires due to its swift control time. This system will reduce potential damage to the facility, reduce potential environmental concerns, and improve the overall life safety concerns.

4.3.1.5.1 Aqueous Film Forming Foam (AFFF)

Aqueous film forming foam (AFFF) is obtained from synthetic fluorochemical surfactants. Foaming agents, stabilizers, and solvents are added to form the concentrate. AFFF is unique because it allows a film of water to form on a hydrocarbon fuel surface. It extinguishes fire by suppressing fuel vapor due to the presence of the aqueous, or watery, film. AFFF comes in both 3% and 6% concentrations.

The air-foams generated from AFFF solutions possess low viscosity, have fast spreading and leveling characteristics, and, like other foams, act as surface barriers to exclude air and halt fuel vaporization. These foams also develop a continuous aqueous layer of solution under the foam, maintaining a floating film on hydrocarbon fuel surfaces to help suppress combustible vapors and cool the fuel substrate. This film, which can also spread over fuel surfaces not fully covered with the foam blanket, is self-healing following mechanical disruption and continues to spread as long as there remains a reservoir of nearby solution.

AFFF fluidity and film strength on kerosene makes it particularly suitable for jet aircraft (JP-5) fuel spill fire fighting.

Actually AFFF has many mechanisms that work together to help extinguish a fire. They come from the aqueous film, the mechanical foam, and the water content. The aqueous film suppresses vapors, improves the spreading ability of the foam, and tends to reseal itself when distributed. The mechanical foam suppresses vapors, and separates the fuel from the air. The water content has a cooling effect.

AFFF is highly recommended for use in fighting hydrocarbon fires due to its swift control time.

There is currently no fixed fire protection system installed in the Red Hill fuel storage area.

4.6.2.9 Fire Suppression

There is no fixed fire suppression in the tank storage area. The highest hazard in this facility is to be found in the lower access tunnel at the valve gallery area for each tank. Due to the quantity of fuel stored in the Red Hill complex and the potential for a fuel release in this area it is recommended that a fixed aqueous film forming foam (AFFF) deluge system be installed at the lower tank storage area. Zoned, open head deluge systems will be automatically actuated by rate compensation thermal detectors (see Exhibit 4-1).

Comments

This recommendation is based upon the experience and engineering judgement of a professional fire protection engineer. The unique configuration of this facility and the potential for fuel release mandate the installation of fixed fire protection.

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