Baltimore Tunnel Fire

National Academy of Sciences

Committee on Transportation of Radioactive Waste

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Presentation by

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On behalf of the

State of Nevada

Why investigate the Baltimore Tunnel Fire?

- Fire appeared to exceed cask design specs
- Calvert Cliffs reactor would use CSX tracks
- What are the implications for cask design, accident probability estimates, emergency preparedness and environmental impact?

Chronology

- 7/18, 3:04 PM, train 1000 yards past south tunnel entrance, traveling 23 mph
- 3:07 PM, emergency brakes activated, train in tunnel, 0.5 miles from northern end, black fumes fill tunnel
- 3:15 PM, train crew uncouples engines, drives out of north end, phones dispatcher
- 3:25 PM, black smoke pouring out of tunnel, crew reaches dispatcher
- 4:15 PM, fire department receives notification, cannot enter tunnel

Chronology (contd)

- 5-6 PM, Coast Guard closes Inner Harbor, fans evacuated from Camden Yards ballpark, roads closed 1.3 miles within inner city, major highways closed, severe gridlock
- 6:15 PM, water main breaks, power failure
- 10 PM firefighters enter tunnel through south end, but, due to the heat, cannot reach the fire
- 7/19, workers begin removing cars from tunnel, car containing tripropylene and burning cars remain
- 7/21, 4 PM, empty tripropylene tanker removed

Steel Temperatures

- 1000 ºF, dark red color
- 1500 ºF, newspaper report
- 1650 ºF, orange
- 1825 ºF, yellow
- 2200 ºF, white

NIST Findings

- Peak calculated temperature 1800 ^{o}F within the flaming region for 1st 3 hours
- Wall surface temperature reached about 1500 ^{o}F
- Steel temperatures of rail cars expected to be similar to gas temperatures

Regulatory Tests

30 foot drop onto essentially unyielding surface

40 inch drop onto
6 inch steel spike

30-minute fire @ 1475ºF

8-hour submersion of undamaged cask under 50 feet of water

Source: Sandia National Laboratories

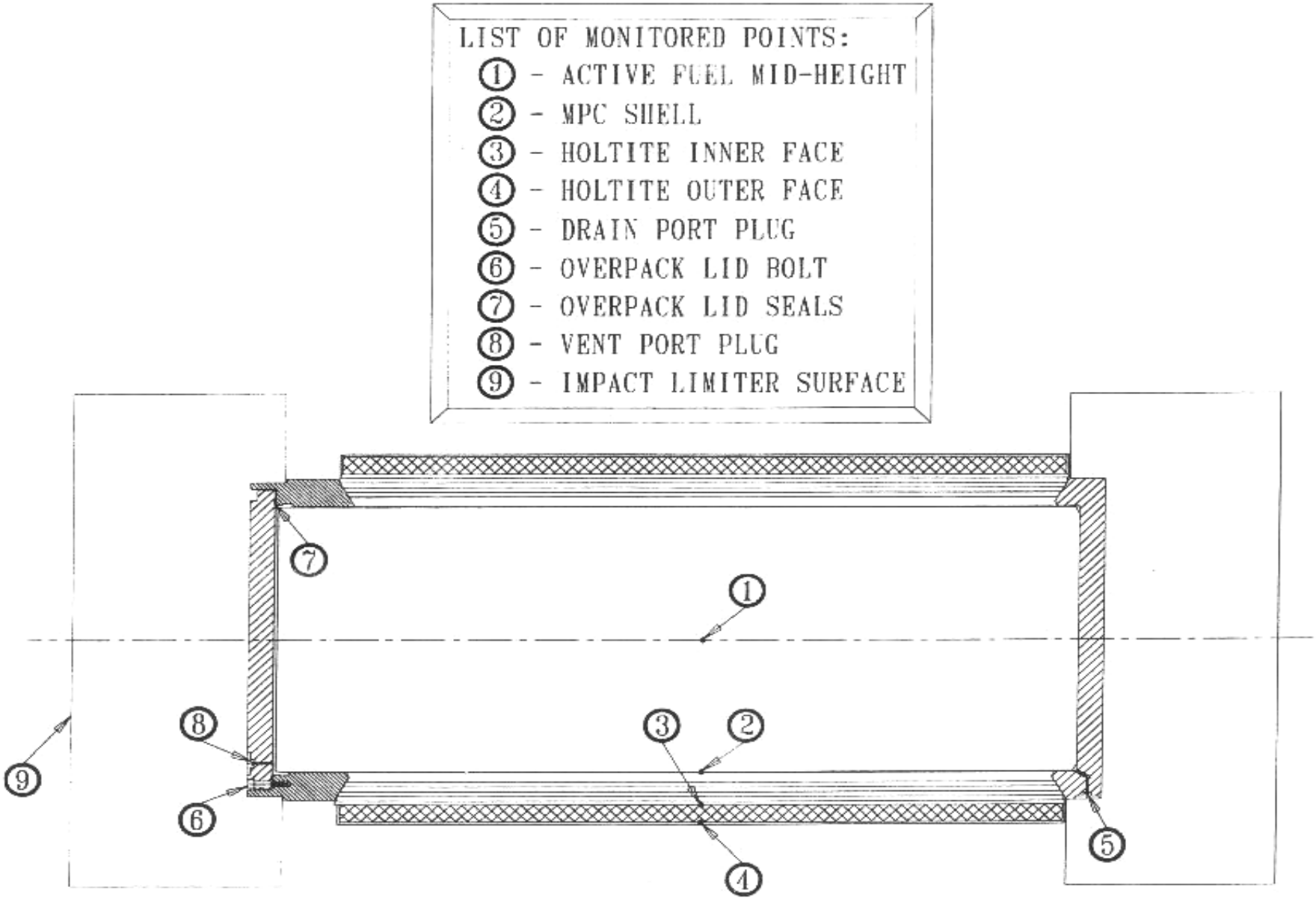
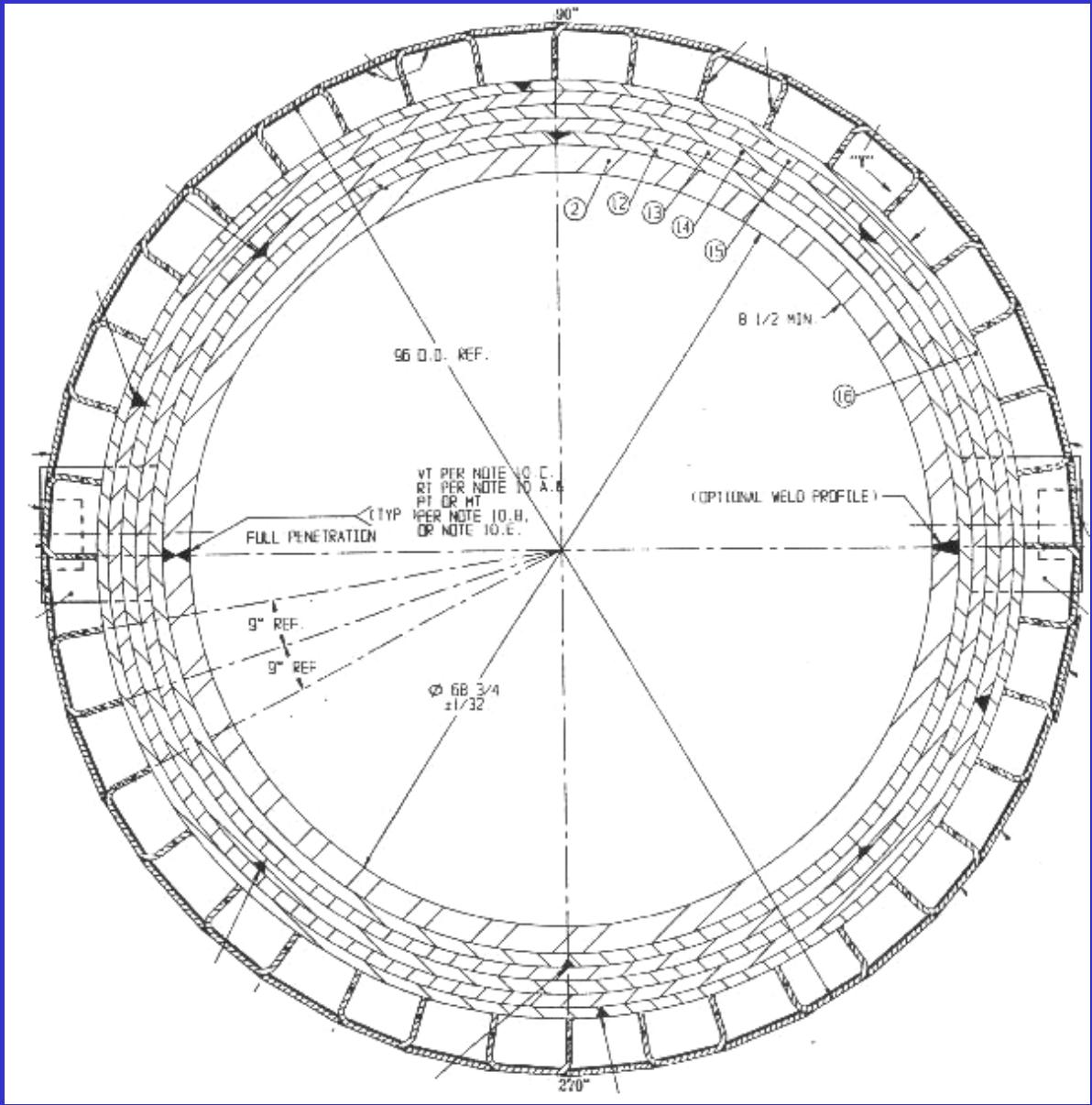
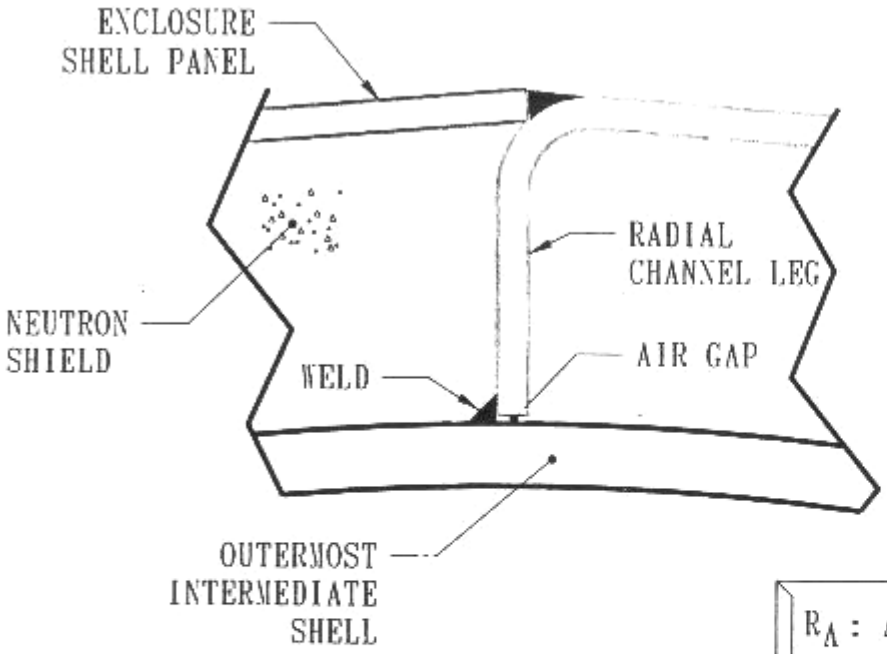


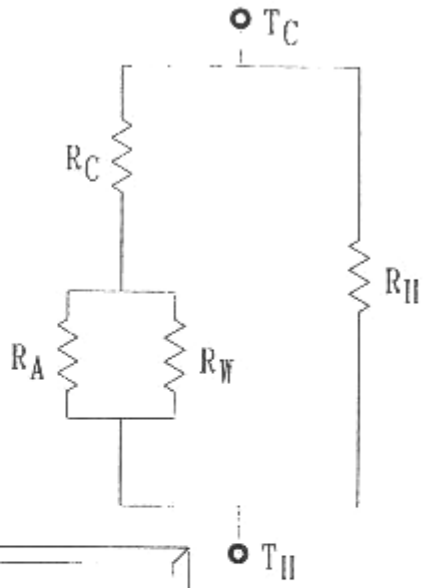
FIGURE 3.5.1; LOCATION OF HI-STAR 100 PACKAGE CONTROL POINTS MONITORED DURING HYPOTHETICAL FIRE ACCIDENT CONDITION

HI-STAR 100 Cross-section



Close-up of Radial Channel





R_A : AIR GAP RESISTANCE

R_W : WELD RESISTANCE

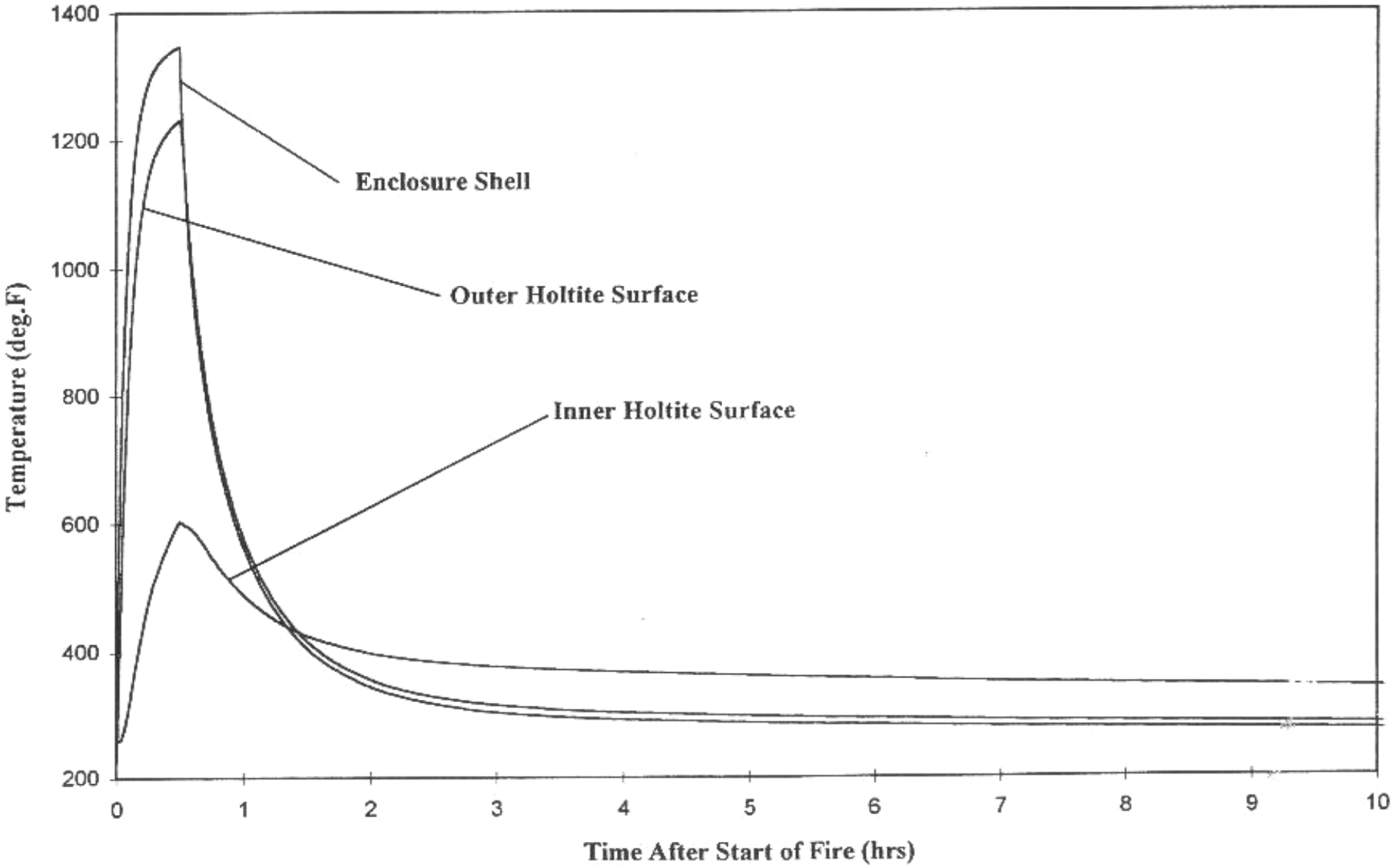
R_C : RADIAL CHANNEL LEG RESISTANCE

R_H : NEUTRON SHIELD RESISTANCE

T_H : HOT TEMPERATURES

T_C : COLD TEMPERATURES

Holtite in a Regulatory Fire



Port Plugs and Bolts in a Regulatory Fire

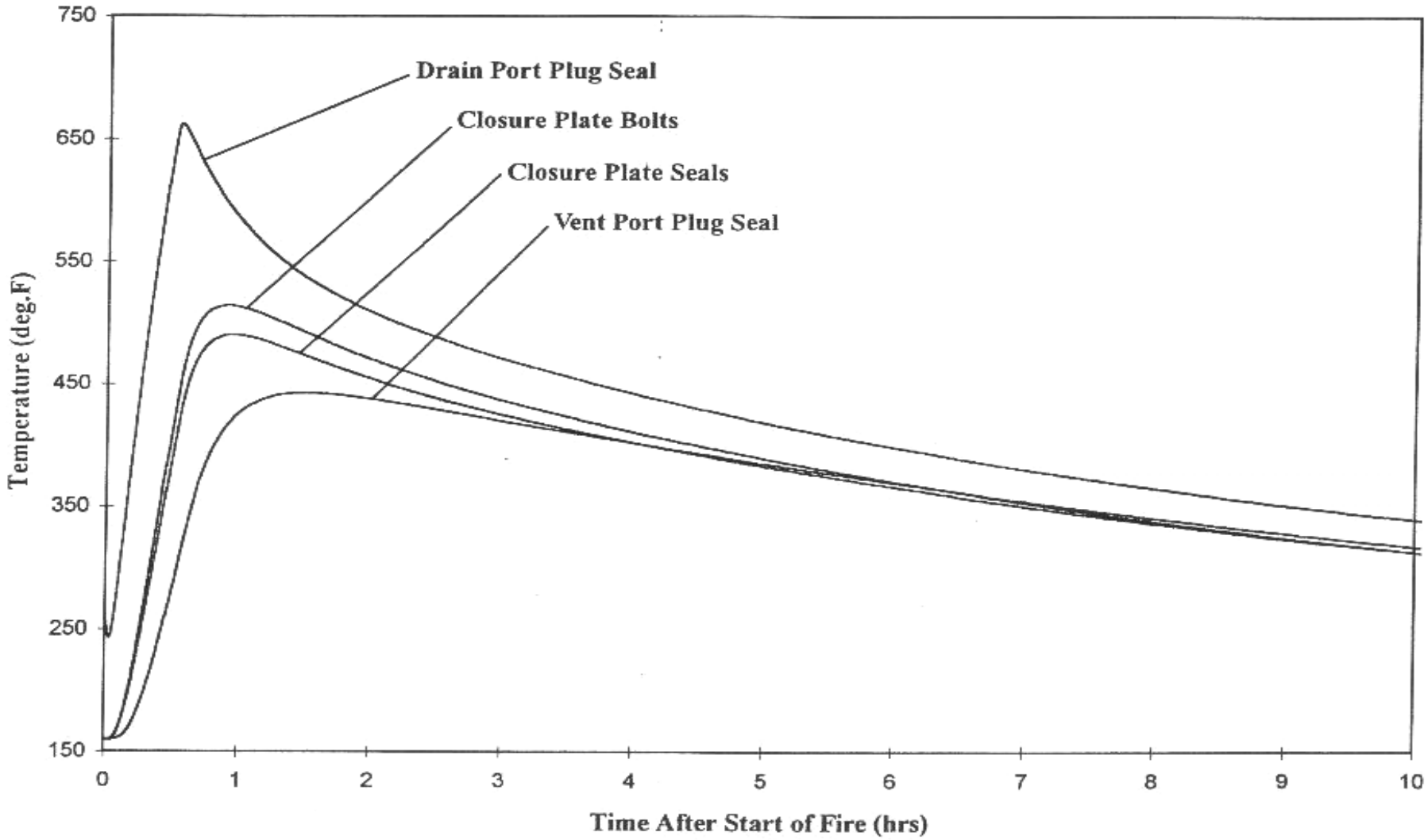


Table 3.5.4

MAXIMUM HI-STAR SYSTEM COMPONENTS AND MATERIALS
TEMPERATURES DURING AND AFTER HYPOTHETICAL FIRE CONDITION

Material/Component	Initial Condition (°F)	During Fire (°F)	Post Fire Cooldown (°F)	Accident Limit (°F)
Fuel cladding	708	708	751	1058
Overpack closure bolts	159	415	514	600
Overpack closure plate seals	160	392	490	1200
Drain port plug seal	259	645	662	932
Vent port plug seal	160	283	443	932
Holtite outer surface	223	1232	1232	N/A[+]
Holtite inner surface	259	604	604	N/A
MPC shell	309	313	419	775
Impact limiter surface	127	983	983	1105
Overpack outer enclosure	226	1348	1348	1350

Comparison IF-300 and HI-STAR

	IF-300	HI-STAR
Assemblies-PWR	7	24
Heat output	45 GWD/MTU, 5-yr	45 GWD/MTU, 5-yr
Loaded Weight	70 tons (+22.5 tons addl parts)	138.7 tons (211 tons on rail)
	Fuel in bolted cask	MPC in overpack

Conclusions

- Need to 3-D model (bolts, seals, etc) more than HI-STAR cask for extreme fire environments.
- For safety and risk analysis, casks should be physically tested to destruction.
- NRC should release all thermal calculations; Holtec is withholding allegedly proprietary information.