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Heat and Smoke Management Guidelines and Fire Fighting Doctrine for the LPD-17 Well Deck and Vehicle Stowage Areas

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The Total Ship Survivability and Battle Damage Repair Assessment (TSS/BDRA) performed on the LPD-17 contract design illustrated the need for fire fighting doctrine and heat and smoke management guidelines for the Well Deck (WD) and Vehicle Stowage Areas (VSAs) of the LPD-17. The TSS/BDRA highlighted several potential problems in the WD and VSAs given a weapon hit scenario. Hit related damage included the release of substantial quantities of Class B fuels (e.g., diesel fuel, JP-5, and MOGAS). Large fires could develop rapidly and be sustained for significant time periods due to the large quantity of oxygen contained in the expansive WD and VSAs. The result was extensive smoke logging of the WD and VSAs, which sharply reduced the visibility throughout these interconnected areas. The potentially large fire sizes would also create high gas temperatures that make fire fighter access, approach, and fire fighting activities difficult. The forced ventilation to this area, which was assumed to remain running for selected hits in the TSS/BDRA effort, supported the continued growth of large fires. The high temperatures and limited visibility prevented expedient access to these areas using standard heat and smoke management doctrine. Also lacking was general fire fighting doctrine for these types of situations.

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NOMENCLATURE

AFFF	Aqueous Film Forming Foam
BDRA	Battle Damage Repair Assessment
CFAST	Consolidated Model for Fire and Smoke Transport
CLASS A FIRE	Fire involving ordinary combustibles
CLASS B FIRE	Fire involving flammable or combustible liquids
CO_2	Carbon Dioxide
DCA	Damage Control Assistant
DC	Damage Control
FAST	Fire and Smoke Transport
FDE	Fleet Doctrine Evaluation
GQ	General Quarters
HVAC	Heating, Ventilation, and Air-conditioning
ISCC	Internal Ship Conflagration Control
LCAC	Landing Craft Area Cushion
LPD-17	Amphibious Dock Ship
LVSA	Lower Vehicle Storage Area
MEFP	Mechanical, Electrical, and Fire Protection
MOGAS	Motor Gasoline
MVSA	Main Vehicle Storage Area
NATOPS	Naval Air Training and Operating Procedures Standardization
NSTM	Naval Ships' Technical Manual
PECU	Portable Endothermic Cutting Unit
PKP	Potassium Bicarbonate Powder
P&S	Port and Starboard
TSS	Total Ship Survivability
UVSA	Upper Vehicle Storage Area
VSA	Vehicle Storage Area
WD	Well Deck

HEAT AND SMOKE MANAGEMENT GUIDELINES AND FIRE FIGHTING DOCTRINE FOR THE LPD-17 WELL DECK AND VEHICLE STOWAGE AREAS

1.0 INTRODUCTION

The LPD-17 Total Ship Survivability and Battle Damage Repair Assessment (TSS/BDRA), which was performed on the contract design, characterized the primary and secondary damage to the ship given several weapon threat scenarios [1]. The ability of the proposed design to resist damage, recover from the threat scenario, and maintain mission capabilities was assessed utilizing the TSS/BDRA framework. The BDRA portion of the evaluation illustrated the need for fire fighting doctrine, which focused on the Well Deck (WD) and vehicle stowage areas (VSAs). There is no general fire fighting doctrine available in the Naval Ships' Technical Manual (NSTM), Chapter 555 "Surface Ship Fire Fighting" [2] that details doctrine to be used specifically in the WD or the vehicle stowage areas. The effort reported in this document focuses on establishing general fire fighting doctrine specifically for the LPD-17 contract design. It is anticipated that the proposed doctrine would be adopted as ship specific fire fighting doctrine.

The TSS/BDRA highlighted several potential problems in the WD and VSAs given a weapon hit scenario. Hit related damage often included the release of substantial quantities of Class B fuels (e.g., diesel fuel, JP-5, and MOGAS). Large fires could develop rapidly and be sustained for significant time periods due to the large quantity of oxygen contained in the expansive WD and VSAs. The result was extensive smoke logging of the WD and VSAs, which sharply reduced the visibility throughout these interconnected areas. The potentially large fire sizes would also create high gas temperatures that make fire fighter access, approach, and fire fighting activities difficult. The forced ventilation line-up to this area, which was assumed to remain running for selected hits in the TSS/BDRA effort, supported the continued growth of large fires. The high temperatures and limited visibility prevented expedient access to these areas using standard heat and smoke management doctrine. Also lacking was general fire fighting doctrine for these types of situations.

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This effort focused on developing the optimal heat and smoke management strategy for the LPD-17 WD and VSAs. An optimum strategy would provide numerous benefits for the ship, including the following:

- Improved accessibility to the WD and VSAs;
- Reduced temperatures that increase the time individual fire fighters can sustain fire fighting activities before requiring relief;
- Improved visibility that allows quicker access to the main fire location; and
- Reduced damage to the vehicles, cargo, and other items that form the nucleus of the ship's mission.

Coupled with the heat and smoke management guidelines are fire fighting doctrine recommendations. Fire fighting operations are a very dynamic entity; however, basic strategies and resource utilization recommendations have been outlined.

2.0 APPROACH

2.1 Assumptions & Limitations

This effort was focused on developing both heat and smoke management guidelines as well as fire fighting approaches specifically in the context of the LPD-17 TSS/BDRA hit assessments. While the underlying principles that were developed in this effort have broader application, the discussion of the heat and smoke management guidelines centers around the hit scenarios evaluated in the TSS/BDRA. The heat and smoke management guidelines are generalized for the WD and VSAs; however, the application of these guidelines has been illustrated for each of the hit scenarios. Manual fire fighting doctrine does not depart from standard Navy practices. Recommendations have been made, in the context of the specific hits, relative to likely access approaches, hose team strategies and ventilation strategies.

This project used the same assumptions that were developed in the TSS/BDRA effort for each of the hit scenarios. The heat and smoke management guidelines address the specific capabilities of the LPD-17 identified in the TSS/BDRA as well as the specific damage cited in this effort. The damage assessments associated with the hits have been anticipated in the heat and smoke management guidelines through contingencies to general doctrine. The general heat and smoke management guidelines have broader application than the three hits involving the WD and VSAs. Sound smoke and heat management guidelines should be robust enough to address the specifics of the three TSS/BDRA hits.

2.2 General Approach

This effort focused on developing compatible fire-fighting doctrine and smoke/heat management guidelines for the LPD-17 WD and VSAs. The approach to the fire fighting doctrine development was to use standard Navy fire fighting doctrine, described in NSTM Chapter 555, as the foundation [2]. The use of fixed systems, damage control equipment, and direct and indirect fire fighting team attacks remains unchanged from standard procedures. The bulk of the development work was centered around managing the heat and smoke buildup in order to maintain an environment that would facilitate fire fighter access and fire fighter activities. The most challenging aspect was to identify the optimum heat and smoke management techniques for use in the WD and VSAs.

Managing the buildup of heat and smoke from large fires in the WD or VSAs was only possible by venting these products. The engineering assessment of potential ventilation strategies to mitigate the buildup of heat and smoke was based on the weapons hit scenarios generated as part of the TSS/BDRA on the LPD-17 contract design. The analysis of ventilation efficacy in reducing the compartment temperatures incorporated the simulation of very large fires in numerous locations throughout the WD and VSAs. Through the use of a multi-compartment fire model, these fires were simulated for a number of ventilation configurations. The benefits associated with the natural ventilation capabilities of the stern gates were assessed. This was followed by configurations that evaluated the effects of mechanical ventilation systems with and without stern gate ventilation. The fires which were evaluated in these simulations were based on those used in the TSS/BDRA. In some cases, the maximum fire sizes were larger than those in the TSS/BDRA to account for the potential of increased fire growth.

The results from this engineering assessment provided the technical impetus to specify general fire fighting doctrine recommendations (primarily access) and heat/smoke management guidelines. These general recommendations also have been refined for each of the specific TSS/BDRA hit scenarios involving fires in the WD and VSAs. The hit specific doctrine is actually an illustration of how the general recommendations should be applied given a certain set of parameters.

3.0 FIRE SCENARIOS

3.1 Description of Well Deck and Vehicle Stowage Areas

The LPD-17 is an amphibious dock ship. Its primary purpose is the transport of military vehicles and support equipment for amphibious landing operations. The Well Deck and vehicle stowage areas are located in the aft portion of the ship. Figures 1 through 4 depict plan and sectional views of the WD and VSAs. These spaces are located in the aft portion of the LPD-17 ship, spanning from Frame 62.5 to the stern (approximately frame 201). The WD and VSAs are comprised of a large open area, measuring approximately 138 m (453 ft) long by 18.5 m (61 ft) wide (the width of the WD varies, ranging from 15.0 m to 20.0 m). This area is actually comprised of several individual areas (well deck, main vehicle stowage area, upper vehicle stowage area, and lower vehicle stowage areas). The flight deck of the LPD-17 is solid, enclosing the WD and VSAs.

Well Deck (WD) The WD is the aft most space. It spans from frame 143 to the stern gates at frame 201. The height of the space from the deck of the WD (2nd Platform) to the underside of the flight deck (Main Deck level) is 11.2 m (36.7 ft). The WD transitions to both the main vehicle stowage area (MVSA) at frame 142 at the 1st platform level and to the upper vehicle stowage area (UVSA) at an intermediate level between the second and third decks. There is no vertical separation at these locations with full bulkheads; rather, stanchions and railings will be employed. Two Landing Craft Air Cushion (LCAC) transports will typically be located in the WD.

Main Vehicle Stowage Area (MVSA) The main vehicle stowage area begins at frame 62.5 and continues to frame 142.5 on the 1st platform. The height of the MVSA is 4.4 m (14.4 ft) from frame 120 forward where the UVSA is located above the MVSA. Aft of frame 120, the MVSA is open to the underside of the flight deck and hangar.

Upper Vehicle Stowage Area (UVSA) The upper vehicle stowage area also begins at frame 62.5 and continues aft to frame 120. The height of the UVSA is 3.8 m (12.5 ft) from the deck to the overhead. The UVSA overlooks the MVSA and WD, and is elevated 4.4 m (14.4 ft) above the MVSA deck level.

Lower Vehicle Stowage Area (LVSA) The lower vehicle stowage areas are located below the MVSA. There are two LVSAs on the 2nd platform level. Both span 32.5 frames. The LVSA Forward begins at

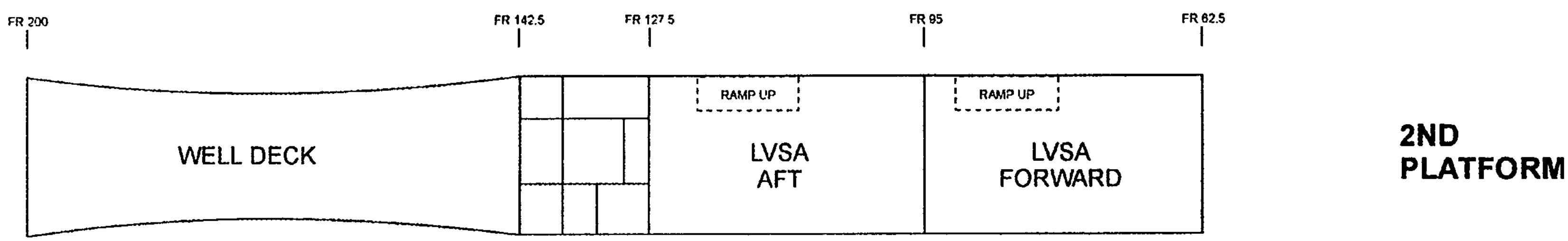


Fig. 1 – Second platform of LPD-17, plan view

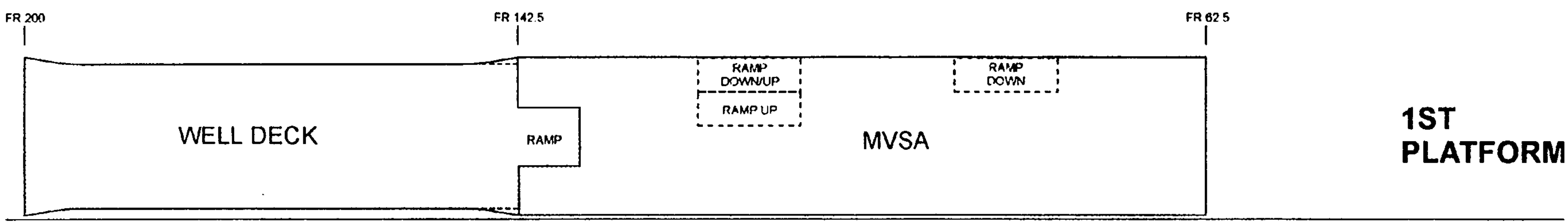


Fig. 2 – First platform of LPD-17, plan view

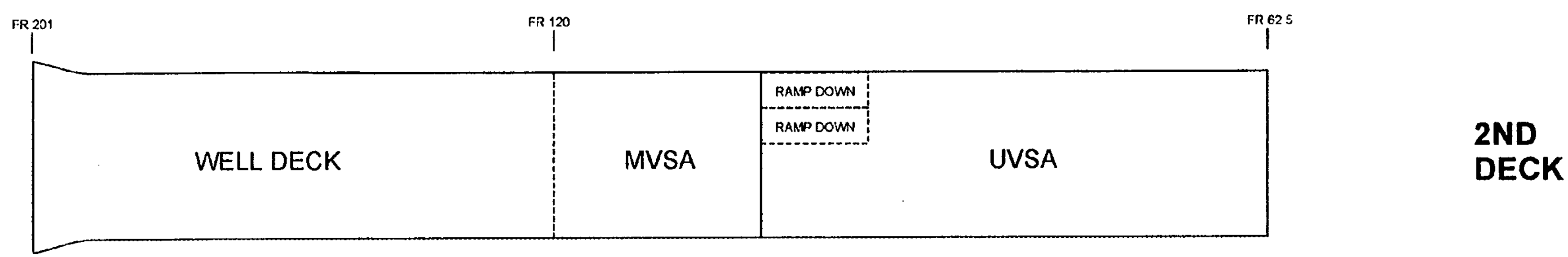


Fig. 3 – Second deck of LPD-17, plan view

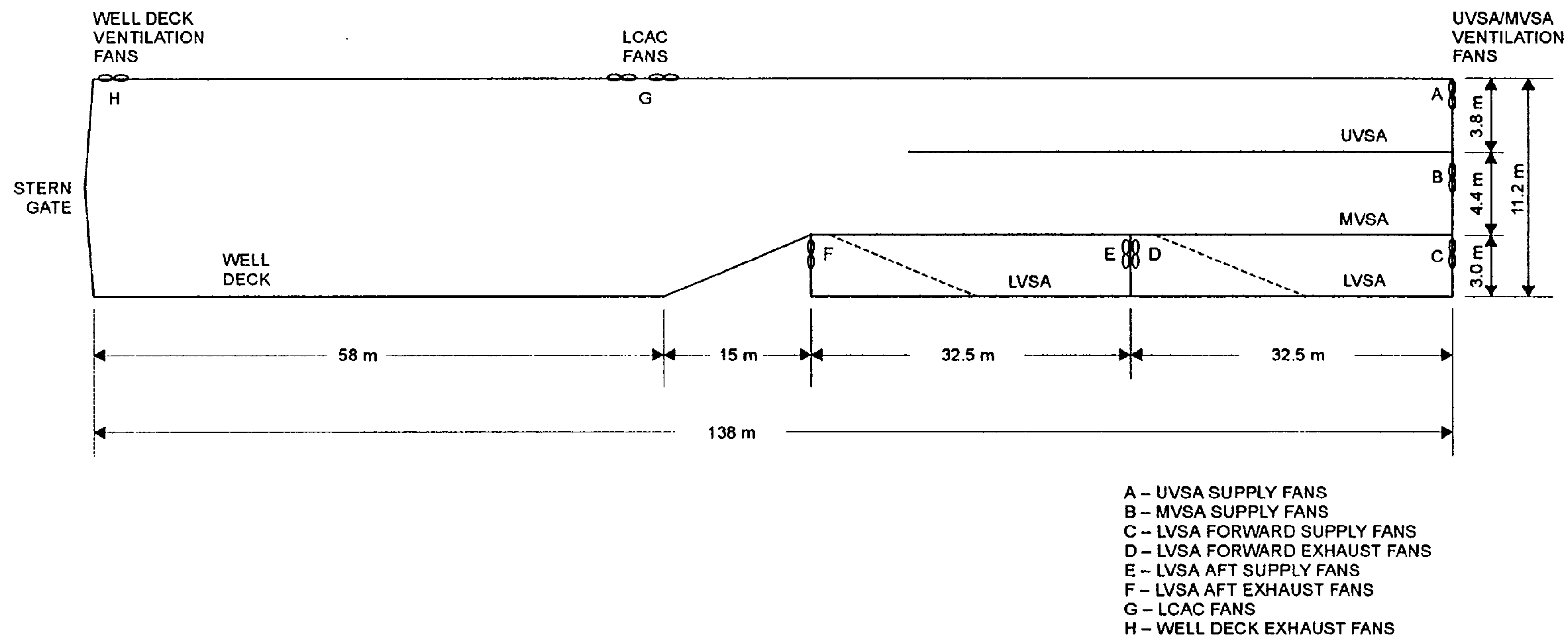


Fig. 4 – LPD-17, section view

frame 62.5 and continues aft to frame 95. The LVSA Aft begins at frame 95, where the LVSA Forward ends and continues aft to frame 127.5. Both the LVSA Forward and LVSA Aft have an overhead height of 3.0 m (9.8 ft).

Ramps, both fixed and movable, connect the WD and various VSAs. These ramps provide access between the spaces for vehicles and crew. A fixed ramp measuring 7.0 m (23.0 ft) wide connects the WD and MVSA. Connecting the MVSA and UVSA are a 4.0 m (13.1 ft) wide fixed ramp and a 4.0 m (13.1 ft) wide hinged ramp located parallel to each other in the aft of the UVSA (frame 102.5 to frame 120). Four-meter wide hinged ramps provide access to each of the LVSAs from the MVSA. All hinged ramps are normally kept in the up-position for steaming conditions. The ramps are lowered as necessary for load-out or embarking operations.

The LPD-17 stern gate will consist of an upper and lower hinged gate, link arms, and operating machinery. The stern gate allows the WD to be opened to weather. Under ballast conditions, the deck of the WD sinks beneath the water level. The WD can then be flooded with water to a depth ranging from approximately 2.4 m (7.9 ft) at the stern to 0.6 m (2.0 ft) near the fixed ramp at frame 142. During load-out or embarking evolutions, lowering the lower stern gate into the water allows boats and/or vehicles to access the water from within the WD.

The upper stern gate measures approximately 4.2 m (13.8 ft) in height, while the lower gate measures 6.8 m (22.3 ft) in height. The stern gate is designed such that the lower stern gate cannot be opened until the upper stern gate is opened and in the locked position. Likewise, the upper stern gate cannot be closed until the lower stern gate is fully closed. The stern gate is powered by hydraulic operating machinery. Local and remote control stations are provided for operating the stern gate. The local controls will be provided in the Port Stern Gate Machinery Room. The remote control station will be located on the third deck portside catwalk bulkhead. Under normal operating conditions, raising or lowering either the upper or lower stern gate can be accomplished within three minutes. However, the upper stern gate must be fully opened before the lower stern gate can be lowered.

There are two emergency operating modes for the stern gate: (1) hand hydraulic pumps, and (2) a manual chain hoist system. The hand hydraulic pumps have provisions to be powered by portable electric motors. The time required to raise or lower the stern gate using the manual hand pumps is not well defined and will depend on a number of factors (e.g., specific malfunction(s) of the stern gate and availability of crew). The design only specifies that the lower gate be capable of being closed within four hours or less. However, the specification does not indicate whether the hand pumps are to be operated by hand or motor to satisfy this time limit. Based on information from the ship architect, the chainfall mode is expected to be faster than the hand hydraulic mode. Using the chain hoist system, the estimated time to open the upper stern gate is approximately 30 to 45 minutes.

The VSAs will be used to stage cargo, military vehicles, and amphibious-type vehicles. Based on proposed load-out diagrams, the spaces will be densely packed and will provide little room for maneuvering during a fire. The UVSA load-out diagrams show nominal aisle widths between cargo and vehicles which range from 0.6 m to 1.5 m (2.0 to 4.9 ft). Similarly, the MVSA aisle widths between vehicles range from 1.0 m to 3.0 m (3.3 to 9.8 ft). Cargo staged in the LVSAs is arranged to provide approximate 1.0 m (3.3 ft) wide access aisles. Because the proposed load-out diagrams may not be representative of actual staging conditions, it is reasonable to assume that direct access through the VSAs may not be available. Crew access may require navigating around (or over) staged cargo to reach other areas of the space.

The hinged ramps serving the UVSA and LVSAs may not be available in an emergency because the normal load-out plan includes vehicle and cargo stowage on top of the hinged ramps, which are normally in the up-position. Therefore, the vehicles and cargo would need to be moved before the hinged ramps could be lowered. The unavailability of the hinged ramps primarily affects access to the LVSAs since these ramps provide the primary means of access to the space.

Two cargo elevators serve the VSAs and may be used to access the various areas if the ramps and/or other access points are not available. Elevator controls are provided at each level and from the machinery spaces served by the elevators. Because there are no ladders or rungs in the elevator shafts, using the elevators for accessing the various spaces is possible only if the elevators are operational.

The WD and VSAs are not manned at all times. When loading and embarking evolutions are underway, crew members will be in these areas. However, under no-threat or General Quarters (GQ) conditions, these spaces will most likely be unmanned.

The WD, MVSA, UVSA, and LVSAs can be monitored from their respective conflag stations. Based on the TSS/BDRA assessment, the fire scenarios evaluated for this task assume that the ship is at GQ. Under these conditions, all conflag stations will be manned. As a result, for the scenarios considered, all areas of the WD and VSAs can be monitored to assist in fire fighting operations, as needed.

Heating, ventilating, and air conditioning (HVAC) systems are provided in the WD and VSAs for normal conditioning of the space. Also, LCAC fans are provided and used during LCAC operations to help clear vehicle exhaust. All of the HVAC systems will utilize reversible fans. The location, normal operating mode, and capacity of each of the HVAC fans in the WD and VSAs are summarized in Table 1.

Table 1 – HVAC Systems

Fan Location	Normal Operating Mode	Capacity L/s (cfm)
UVSA, forward bulkhead	Supply	42,500 (90,050)
MVSA, forward bulkhead	Supply	42,500 (90,050)
LCAC, P/S wingwalls (at approximately Frame 140)	Supply	160,450 (339,966)
Well Deck, aft bulkhead	Exhaust	85,000 (159,975)
LVSA, forward bulkhead	Supply	10,138 (21,480)
LVSA, aft bulkhead	Exhaust	10,138 (21,480)

The WD and VSAs are provided with manually operated aqueous film forming foam (AFFF) deluge sprinkler systems. The AFFF systems are the primary means of controlling a fire in these spaces. The systems will consist of sprinkler zones in the WD and VSAs. Each of the AFFF zones are individually controlled from the conflag stations.

3.2 Overview of Hit Scenarios

The fire fighting doctrine was developed to specifically address the weapons hit scenarios considered in the TSS/BDRA that resulted in large Class Bravo (B) fires in the WD or VSAs. Three specific weapons hit scenarios addressed in the TSS/BDRA evaluation resulted in representative fires and have been addressed in this analysis: Hit 2, Hit 6, and Hit 8A. For each of the hit scenarios, various damage and fire spread occurs as documented in the TSS/BDRA. The extent of damage to fire protection and mechanical systems has a significant impact on the recommended fire fighting doctrine and smoke/heat management guidelines. Therefore, determining the availability of systems for each scenario is important. Table 2 summarizes the availability of the fire suppression and mechanical systems applicable to the fire fighting doctrine for each of the hit scenarios.

Table 2. Availability of Fire Suppression and Mechanical Systems

System	Hit 2	Hit 6	Hit 8A
Overhead AFFF	• Not Available in LVSA Forward • Available in all other areas	• Not available in MOGAS spaces • Available in all other areas	• Not available during first 15-20 minutes
Ventilation System	• Available	• Available	• Only forward supply in MVSA and UVSA is available
Stern Gate	• Available	• Available	• Electrical power not available during first 15-20 minutes

Other factors also impact the specific recommendations for fire fighting and heat management, such as resulting fire size/location, available access locations, and damage to other areas of the ship. Of these, fire location can require fundamentally different strategies to fire fighting and heat/smoke management. The LVSA compartments are much smaller than the other VSAs. The LVSA compartments cannot be ventilated via the stern gate under steaming conditions as reflected in the TSS/BDRA. This is because the vehicle ramps must be lowered before there is access to the LVSA compartments from the MVSA level. The LVSA compartments, given large Class B fire scenarios, can be characterized like machinery spaces in terms of appropriate fire fighting and heat/smoke management techniques. The WD, UVSA and MVSA all have an open configuration which provides numerous options for natural venting via the stern gate as well as mechanical ventilation.

3.2.1 Hit 2

The Hit 2 scenario is based on a weapon penetrating a port ballast tank adjacent to the LVSA Forward compartment. Blast damage results in rupture of a tank containing approximately 7,000 gallons of fuel that subsequently ignites in the ballast tank area. Damage also occurs to several vehicles in the LVSA Forward compartment resulting in several hundred gallons of diesel fuel spilling onto the deck and becoming involved in the fire.

The following assumptions were made as part of the TSS/BDRA for the Hit 2 scenario:

- The AFFF sprinkler system in the LVSA Forward is not operational due to blast damage to the pipe network in the LVSA. The AFFF sprinkler systems in other areas are not damaged and are available.
- The hinged ramp serving the LVSA Forward from the MVSA is in the up-position, secured and watertight. Blast damage renders the ramp inoperable.
- The ventilation system in the LVSA Forward is operational. The LVSA Forward is provided with two supply points on the ceiling near the forward bulkhead, and two exhaust points located on the upper half of the aft bulkhead. The exhaust and supply fans each have a flow rate of 4.83 m^3/s (10,250 cfm).

This scenario results in a large Class B fire involving the contents of LVSA Forward. The only natural ventilation (i.e., opening to weather) available to supply the fire with oxygen is a small 0.09 m^2 (1 ft^2) opening resulting from the weapon entry. However, the TSS/BDRA assumed that the LVSA ventilation systems were operating for the duration of the scenario, which resulted in a relatively large sustained fire (approximately 10 MW).

The primary threat of fire spread for this scenario is the fire exposure to the deck of the MVSA located above the LVSA. Based on the TSS/BDRA analysis, which did not consider the effect of the AFFF sprinkler systems in areas outside the LVSA, fire was assumed to spread to the VSAs and WD in the Hit 2 scenario. In developing the fire fighting doctrine for this scenario, the primary goal was to confine the fire to LVSA Forward and protect the vehicles/cargo in the MVSA and UVSA.

3.2.2 Hit 6

The Hit 6 scenario is based on a weapon penetrating the port side of the ship in the forward area of the WD. The hit results in blast damage to the WD, MVSA, and UVSA in addition to service and storage areas on the port side of the WD. Hit 6 results in the breach of a fuel tank and several containers of oils and other flammable/combustible liquids. As a result, large Class B fires threaten the WD and VSAs.

The following assumptions were made as part of the TSS/BDRA for the Hit 6 scenario:

- The AFFF sprinkler systems are not damaged and are available in all spaces.
- The hinged ramp serving the UVSA from the MVSA is in the up-position and secured.
- The ventilation systems serving the WD, MVSA and UVSA are operational.

Hit 6 results in an opening to weather, measuring approximately 15 m^2 (162 ft^2), which is capable of supporting a large fire in the WD and/or VSAs. A fire size of approximately 15 MW is anticipated in the WD and VSAs. The primary threat of this scenario is heat damage and fire spread to the vehicles and cargo in the VSAs.

3.2.3 Hit 8A

The Hit 8A scenario is based on a weapons hit through the flight deck detonating in the WD area. The hit results in extensive damage to the WD and VSAs. Several vehicles in the MVSA are damaged, which results in their fuel tanks being ruptured. As a result, a large Class B fire involving several hundred gallons of fuel burns in the MVSA.

The following assumptions were made as part of the TSS/BDRA for the Hit 8A scenario:

- The AFFF sprinkler systems serving the WD, UVSA, and MVSA are damaged and are not available during the first 15-20 minutes.
- The hinged ramp serving the UVSA from the MVSA is in the up-position and secured.
- The ventilation systems serving the WD, MVSA and UVSA are damaged. Only the forward supply fans located in the MVSA and UVSA are available.
- Electrical power is not available aft of frame 110, from the main deck and below during the first 15-20 minutes.

Hit 8A results in an opening to weather, measuring approximately 10 m^2 (108 ft^2), which is capable of supporting a relatively large fire in the WD and/or VSA. A fire size of approximately 15 MW is anticipated in the MVSA for this scenario. The primary threat of Hit 8A is heat damage and fire spread to the vehicles and cargo in the VSAs.

Because electrical power is lost aft of frame 110 for the first 15-20 minutes, stern gate operation during this time is via manual means only. Also during this time, the AFFF proportioning stations are not available, either because of power loss or damage to firemains. The firemain and proportioning stations are restored about 15-20 minutes into the scenario. However, the AFFF grid piping in the WD overhead is damaged by the weapon hit, which limits the system's effectiveness even when the proportioning stations are restored and available.

The overpressure resulting from the weapon hit results in failure of all access doors serving the WD, UVSA, and MVSA. The TSS/BDRA assumed that doors were blown off their hinges and treated these doors as not presenting an obstruction to fire and smoke spread. However, the damage assessment for the Hit 8A scenario assumes that access through the blown off doors will still be available. The assumption that the doors are completely gone is not worst case relative to the issue of damage control and fire fighter access.

4.0 GENERAL DOCTRINE

The WD and VSAs present two basic situations for the development of fire fighting doctrine: an open arrangement with natural ventilation capabilities to the weather represented by the WD, UVSA, and MVSA; and, an enclosed arrangement represented by the LVSA Forward and LVSA Aft. The open arrangement is facilitated by the WD stern gate which opens to weather and the open architecture between the WD, MVSA, and UVSA. Air is free to move between these spaces and out to the weather when the stern gate is open. The two LVSA compartments are completely enclosed when the vehicle ramps are in the up position (expected state for steaming conditions). The LVSA compartments, as such, are similar to machinery spaces in terms of congested, enclosed spaces with limited access.

The basic fire fighting doctrine established in the Navy Standard Technical Manual, Chapter 555, "Surface Ship Fire Fighting" provides the foundation for fighting fires in the WD and VSAs. Since the likelihood of a Class B fire in these areas is high given a weapons hit scenario, the doctrine for use of fixed AFFF fire fighting systems and manual fire fighting procedures for AFFF handline attacks will be central to damage control activities. NSTM 555 thoroughly covers Class B fire fighting tactics, procedures and equipment.

4.1 WD and VSA Fire Fighting Equipment

The WD and VSAs have complete AFFF overhead sprinkler system coverage. Since the total aggregate area protected by overhead AFFF systems is very large, there are zoning requirements to ensure adequate application densities. AFFF hose reels, each with 38.1 m (125 ft) of hose, will be installed such that every area throughout the WD and VSAs can be covered by 2 hose streams. Portable carbon dioxide (CO_2) and PKP extinguishers will be installed according to the LPD-17 ship specifications throughout the WD and VSAs. The VSAs will be outfitted with addressable analog heat detectors. Several conflag stations have been incorporated into the ship design such that all areas in the WD and VSAs can be monitored. These conflag stations will be manned; alternatively, remotely operated cameras will be installed to ensure that cargo areas will be monitored.

The importance of activating AFFF overhead systems cannot be understated in terms of limiting the damage to vehicles and cargo located in the midst of a large Class B fire as well as preventing further fire spread and development. The addressable analog heat detectors located throughout the VSAs can help identify fire locations to aid in quickly activating the appropriate AFFF overhead systems. Delays on the order of 8 to 10 minutes can result in complete loss of the vehicle and cargo [3]. Rapid application of AFFF in appropriate quantities can potentially reduce fire induced damage to vehicles and cargo. Rapid application is defined as system activation within two to three minutes [3]. While overhead AFFF systems can be effective in controlling large Class B fires and potentially limiting damage to vehicles immersed in such fires, shielded fires and burning vehicle tires have been identified as complicating issues [3].

4.2 Activation of Fixed Fire Fighting Systems

The first damage control action recommended for a large Class B fire in the WD or VSAs is to activate the overhead AFFF sprinkler system in order to control the fire. No modeling or analysis was performed to support this recommendation, as the significant benefit of AFFF sprinkler system application for controlling Class B fires in WD scenarios is generally known [3]. The operation of the overhead AFFF systems can be controlled from the appropriate conflag station.

4.2.1 Overhead AFFF Sprinklers and Vehicles

The full scale testing of overhead AFFF systems with full scale vehicles have captured the limitations of such protection. The presence of vehicles in the midst of large Class B fires creates shadowed pool fires under the vehicles which act as obstructions. The AFFF overhead sprinklers can knock down the majority of flames in a manner which protects the ship; however serious damage to the vehicles may be inevitable. Foam from the overhead AFFF sprinklers may not penetrate and extinguish shielded Class A fuels that extend above the pool fire. Dual truck tires and the spare tires stored under the truck frame will burn readily and cannot necessarily be extinguished. When the loadout is characterized by close packing of vehicles, extensive difficulty with access and extinguishment of tire fires with handlines can be expected [3].

4.2.2 Vehicle Tire Fires

The involvement of tires can be expected given Class B fires in the VSAs. Several fire fighting agents (water, AFFF, and PKP) have the ability of suppressing the flames. The most difficult aspect of extinguishment is that application of agent cannot be maintained until sufficient cooling takes place to prevent glowing combustion under the char from causing reignition and flaming combustion. Mop-up and overhauling operations will be complicated due to the contribution of tire fires [3].

4.2.3 Overhead Sprinkler System Damage

Even with the complications of fighting fires in the WD and VSAs, the AFFF overhead systems will be a beneficial asset in gaining control of the situation. If the sprinkler system is damaged or made unavailable due to a weapons hit, two potential actions are recommended:

- Attempt to fix or bring on-line the AFFF overhead systems; and/or
- Flow AFFF or water through damaged systems.

NSTM 555 outlines standard procedures for repairing sprinkler mains and remedying other common problems. The On Scene leader and DCA would assess the feasibility of repairing the systems and would allocate manpower accordingly. The damaged overhead sprinkler systems should still be used if AFFF or water can be delivered to the fire area. Although applying AFFF or water through damaged sprinkler piping may have reduced effectiveness, it is believed that the addition of water to the space will assist in cooling the hot gas layer and can help limit fire spread by pre-wetting target fuel objects. Also, AFFF discharged from damaged pipes may flow to the deck and control/extinguish pool fires, which may be useful. Water-only discharge may extinguish Class A fires associated with LCACs or other vehicles (see Ref. 3). Water-only discharge after sustained AFFF discharge may disrupt the protective layering and cause re-ignition of previously extinguished fuel surface areas. Also, water may "float" fuel, spreading it to other adjacent areas. The extent to which a damaged sprinkler system should be used, with or without

AFFF, must be determined by the On Scene leader and DCA based on the specific conditions of the incident.

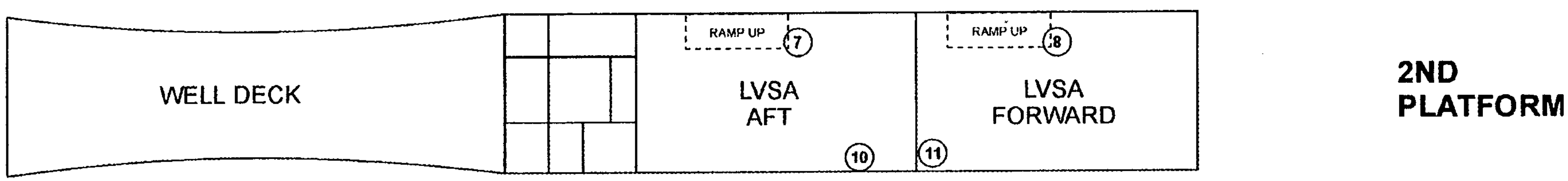
4.3 AFFF Handlines and AFFF Hose Reels

Manual fire fighting activities in the WD and VSAs can use the resources of either the AFFF hose reels or the fire main system, as available. The guidance for direct and indirect attacks as outlined in NSTM 555 [2] should be used for manual fire fighting. If burning liquid fuel (e.g., JP5, diesel fuel) is encountered, the use of AFFF is recommended. The AFFF hose reels will be the most convenient and most rapidly deployable method to manually apply AFFF to the Class B fire. Standard 3.8 cm (1.5 in) hose lines with AFFF eductors can also be used to provide manual AFFF fire fighting capabilities. However, an attack handline cannot exceed six hose lengths (300 ft) of 3.8 cm (1.5 in) line if an AFFF eductor is used with 19 liter (5 gallon) cans of AFFF concentrate. If greater lengths are required, then the use of 6.4 cm (2.5 in) hose in combination with the 3.8 cm (1.5 in) hose lay will help to minimize friction loss and maintain proper nozzle pressure. Nozzle operations should be kept to a minimum until the primary location of the fire has been determined. Multiple entries or the use of indirect fire fighting techniques may be required if heat denies access and/or a direct attack on the seat of the fire is not successful.

4.4 General Fire Fighting Access

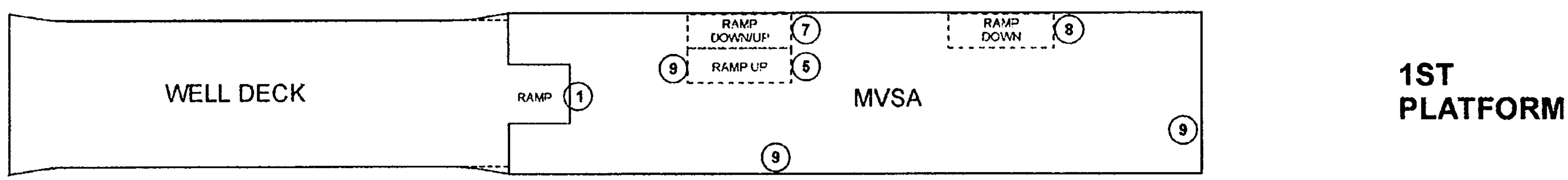
An anti-ship weapon hit to the WD or VSAs poses unique fire fighting challenges due to the fire space volume, magnitude of obstruction and the limited fire attack entry points. Although the threat of flashover is low, the potential for large Class B fires requiring long hose runs and entry from above the fire source warrants special consideration and planning to ensure a safe and effective fire attack.

Table 3 summarizes the access points for the WD and VSAs. The location of the access locations is illustrated in Figures 5 through 7.



(7) Hinged ramp down from MVSA at Frame 120
(8) Hinged ramp down from MVSA at Frame 92
(10) Escape trunk at Frame 101
(11) Escape trunk at Frame 93

Fig. 5 – Second platform of LPD-17, access points



(1) Fixed ramp between WD and MVSA at Frame 132.5

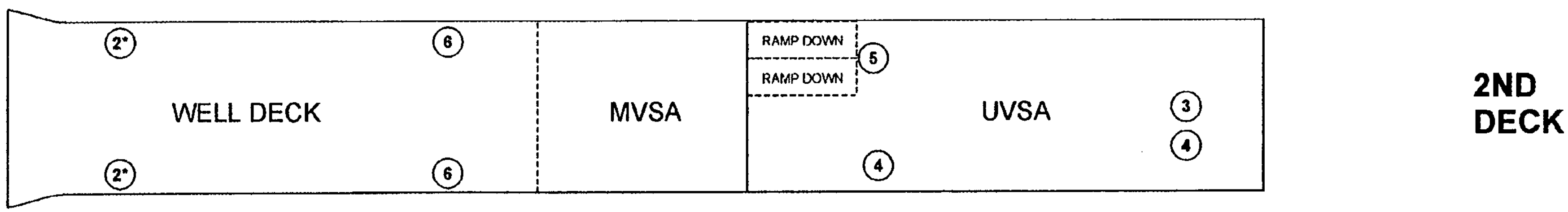
(5) Fixed ramp between MVSA and UVSA at Frame 105

(7) Hinged ramp to LVSA aft at Frame 120

(8) Hinged ramp LVSA forward at Frame 92

(9) Cargo elevators: No. 1 located at Frame 59.5 and No. 2 located at Frame 103.5, both at MVSA level

Fig. 6 – First platform of LPD-17, access points



*Located at
Third Deck Level

(2) Access trunks to 3rd deck catwalks on port and starboard wingwalls at Frame 187
(3) Access from Troop Living Space airlock into UVSA at Frame 62.5
(4) Cargo Elevators: No. 1 located at Frame 59.5 and No. 2 located at Frame 103.5, both at UVSA level
(5) Fixed ramp down to MVSA at Frame 105
(6) Access to 3rd Deck port and starboard platform and to MVSA via ladders from wingwall doors (port and starboard) at Frame 147

Fig. 7 – Second deck of LPD-17, access points

The primary entry points are from the Second Deck forward Troop Living Space at Frame 62.5 (ID No. 3) or the Second Deck platform P & S doors at Frame 147 (ID No. 6). These locations provide direct access from the Second Deck to the UVSA and MVSA, respectively, and indirect access to the WD via the fixed MVSA ramp at Frame 132.5 (ID No. 1). The Second Deck platform ladderways (port and starboard) provide the optimum entry point from the Repair Three areas. This enables easier access around obstructions in the VSAs and minimizes the number of hose lengths required for a handline attack. If the Second Deck platform entry points (port and starboard) are obstructed by fire or the primary fire source is known to be in the UVSA, then a fire attack initiated from the forward Troop Living Space would be most advantageous. All other locations with the exception of the Cargo Elevators and LVSA Escape Trunks provide access only to catwalks overlooking the WD and will not permit access to the WD or VSAs. There are ladders which can be used to go from the catwalks to the UVSA level. Depending upon the fire location and the extent of heat and smoke accumulation, the catwalk access points may not be usable.

4.5 Manual Fire Fighting Effectiveness

The original TSS/BDRA made important assumptions regarding the effectiveness of the fire fighters engaged in manual fire fighting operations. The assumptions optimistically assumed that the fire fighters were well trained and performed their duties effectively. A recent assessment of numerous Fleet Doctrine Evaluation (FDE) tests conducted on the ex-USS SHADWELL has shown that threats and activities encountered in FDE evolutions are not replicated in Navy training scenarios [4].

Table 3. Summary of Well Deck and VSA Access Locations

ID No.	Access Location	Notes
	Well Deck	
1	First Platform – down ramp located at Frame 132.5 from MVSA.	Only access point to deck level of WD.
2	Third Deck – access trunks located port & starboard at Frame 187.	Provides access to the 3rd Deck catwalks located on the port and starboard wing walls of the WD.
	Upper Vehicle Storage Area	
3	Second Deck – from Troop Living Space located at Frame 62.5.	Provides access point to the VSAs. Entry is through an airlock and a small set of steps between the Troop Living Space and UVSA.
4	Second Deck – Cargo Elevator No.1 located at Frame 59.5 & Cargo Elevator No.2 located at Frame 103.5.	Elevators may not be available if damaged or power is lost. There are no ladders or rungs in the shafts to allow climbing between decks if the elevator is not operational.

Table 3. (cont.) Summary of Well Deck and VSA Access Locations

ID No.	Access Location	Notes
	Main Vehicle Stowage Area	
5	Second Deck – Down fixed ramp located at Frame 105 from UVSA.	Requires access through UVSA.
6	Second Deck – door from passage located port & starboard at Frame 147.	Provides access down to 3rd deck P&S platform and down to MVSA at Frame 140.
7	First Platform – down hinged ramp located at Frame 120 from MVSA.	Hinged ramp may not be available if damaged, power is not available, or obstructed by vehicles.
	Lower Vehicle Stowage Area (Forward)	
8	First Platform – down hinged ramp located at Frame 92 from MVSA.	Hinged ramp may not be available if damaged, power is not available, or obstructed by vehicles.
9	First Platform – Cargo Elevator No. 1 located at Frame 59.5 & Cargo Elevator No. 2 located at Frame 103.5.	Elevators may not be available if damaged or power is lost. There are no ladders or rungs in the shafts to allow climbing between decks if the elevator is not operational.
	Lower Vehicle Stowage Area (Aft)	
10	Second Platform – Escape Trunk located starboard at Frame 101.	Access to Escape Trunk provided at Second Deck.
11	Second Platform – Escape Trunk located starboard at Frame 93.	Access to Escape Trunk provided at Second Deck.

4.6 General Ship Response

The orientation of the ship with respect to the prevailing wind can impact the venting of smoke and heat to the weather. The ship's course, if possible, should be altered to point the bow into the wind at an appropriate angle in order to create a negative pressure (relative) on the openings which could vent smoke and heat to the weather. The two most likely openings are the weapon entry point and the stern gate. This strategy is generally acknowledged in the NATOPS manual [5] and specifically with regard to LPD class ships.

The issue of providing additional ventilation to the WD and VSAs was raised in light of the limited access as well as the potential for very large and rapid fire development to take place. Numerous ventilation strategies were evaluated in the effort to evaluate the benefits of actively ventilating the fire compartments. Qualitative benefits which were identified as potential outcomes of actively ventilating the fire compartment are:

- Reducing the thermal stress to the shipboard fire fighters
- Improving fire fighters access and visibility
- Aiding manual fire fighting operations by cooling the environment and controlling smoke movement while the fire attack team(s) approach the lower deck levels of the WD or the VSAs; and
- Enhancing fire containment/ boundary cooling operations for uninvolved areas and helping with the coordination of multiple attack team operations if needed.

Since the general fire fighting guidance found in NSTM 555 does not support active ventilation of fire compartments (NSTM 555 does allow active desmoking under certain conditions), the evaluation and analysis addressed the two most significant concerns with actively ventilating Class B fires:

- The potential to feed oxygen to a fire that would otherwise become oxygen limited; and
- Increase the potential/rate for fire spread to contiguous fire packages and adjacent uninvolved spaces.

These issues have been addressed in Section 5.0, which follows, that details the technical evaluation of active ventilation strategies.

5.0 VENTILATION EVALUATION

5.1 Approach

The original TSS/BDRA work captured the difficulties associated with fire fighting and damage control activities in the WD and VSAs given large Class B fires resulting from weapons hit scenarios. These hit scenarios did not evaluate alternative ventilation strategies. An engineering evaluation was performed to identify the best method for managing the buildup of smoke and heat in the event of such large Class B fires. There are four basic options for managing smoke and heat accumulation, as follows:

1. Provide no ventilation to the WD or VSAs;
2. Provide only natural ventilation to the WD, MVSA, and UVSA by opening the stern gate;
3. Provide only mechanical ventilation to the WD or VSAs; and
4. Provide some combination of natural and mechanical ventilation.

These four strategies have been evaluated to determine the effectiveness of each option. The relative complexity of each strategy was also assessed; the list above is in descending order from simple to complex. In order to evaluate the effectiveness of these various strategies, specific criteria needed to be established as measures of performance. Once these criteria were identified, computer simulations were performed to assess the impact of large Class B fires under different conditions.

5.2 Evaluation Criteria

The primary objective of smoke and heat management is to enable the fire fighters to access the WD or VSA in order to fight the fire. The secondary objective is to minimize or prevent damage that would compromise the primary and secondary mission capabilities of the ship. Thermal damage to the vehicles and equipment stored in the WD and VSAs is the predominant concern in this context. Establishing tenability criteria and thermal failure criteria was necessary to measure the performance of various resource configurations. The criteria used to measure the differences in performance for the various ventilation arrangements in this project are described in the following sections.

5.2.1 Human Tenability and Fire fighter Access

There are numerous data sources in the literature regarding tenability of unprotected personnel. Temperature effects for unprotected personnel from several sources have been compiled as shown in Table 4 [6].

Table 4. Temperature Effects for Unprotected Personnel [6]

Temperature	Effects
100 °C (212 °F)	skin burns rapidly in humid air
127 °C (260 °F)	difficulty breathing
140 °C (284 °F)	5 minute tolerance time
149 °C (300 °F)	breathing difficult, temperature limit for escape
182 °C (360 °F)	irreversible injury for 30 second exposure
204 °C (400 °F)	respiratory system tolerance level

The Naval Ships' Technical Manual (NSTM) Chapter 555, Volume 1, Surface Ship Fire Fighting [2] also identifies the thermal limits associated with human tolerance to heat. Table 555-1-7 of NSTM 555 has been reproduced in Table 5.

Table 5. NSTM 555 Human Tolerance to Heat [2]

Hot Air Exposure	
Temperature	Effects
90 °C (200 °F)	Incapacitation in 35 minutes, death in 60 minutes
150 °C (300 °F)	Incapacitation in 5 minutes, death in 30 minutes
190 °C (380 °F)	Immediate incapacitation, death in 15 minutes
200 °C (400 °F)	Irreversible respiratory tract damage
340 °C (650 °F)	Immediate blistering

These data points indicate that unprotected personnel cannot withstand very high temperatures. The relative humidity of the air also plays a critical role in determining the effects on personnel. For situations where the humidity levels are high (e.g., fire environments, especially during active fire fighting), steam present at 100 °C (212 °F) will result in severe injuries (e.g., burn injuries, incapacitation, death) to unprotected personnel. Burn injuries were noted in the Internal Ship Conflagration Control (ISCC) fire tests [7] which were performed as a result of the USS STARK incident. A conservative tolerance criteria is 100 °C for unprotected personnel.

Fire fighters outfitted with fire fighting ensembles can tolerate higher thermal exposures compared to unprotected personnel. There is limited quantitative data for thermal tolerances associated with fire fighters in full ensembles. Qualitative criteria were identified based on Fleet Doctrine Evaluations involving the response of trained fire fighting crews to actual fires in a shipboard environment [8]. Experienced and highly trained fire fighting crews optimally can enter and fight fires in environments of approximately 200 °C (392 °F) for 10 minutes. The duration associated with fire fighters actively "working" in fire environments of 150 °C (302 °F) and less are not expected to exceed 15 minutes. Unseasoned or inexperienced fire fighting crew may be adverse to entering compartments when temperatures exceed 150 °C. NSTM provides estimates for fire fighter duration based on the ISCC testing [9, 10]. These durations span from less than 10 minutes for high heat stress environments to as long as 30 minutes.

The relationship between fire fighting duration and compartment temperatures is significantly impacted (i.e., degraded fire fighter duration and capabilities) by the generation of steam which results from fire hose discharges. The resulting steam can cause significant burns and drive the fire fighters from the compartment. These qualitative results have been summarized in Table 6 [8].

Table 6. Fire fighter Tolerances to Heat

Fire fighters Experience	Effects on Fire fighters in Full Ensembles	
	Successful Entry	"Working" Duration
High	Up to 200 °C	10 minutes maximum with 200 °C temperatures
High	Up to 200 °C	15 minutes maximum with temperatures at or below 150 °C
Low	Below 150 °C	15 minutes maximum for temperatures below 150 °C

The thermal criterion for heat management chosen for this engineering assessment is 150 °C (302 °F). If the environmental temperatures can be maintained below 150 °C, two important capabilities are sustained:

(1) The maximum duration of actively combating the fire for fire fighters in full ensembles can be realized; and

(2) The probability of unseasoned or untrained fire fighters accessing the compartment to contain the fire is significantly increased.

There is no guarantee that the fire fighters responding to a fire which results from a weapons hit will be highly trained or experienced. Furthermore, even if highly trained fire fighters are available, the maximum time frame for working the fire should be monitored and managed by the damage control (DC) personnel as recommended in NSTM 555. This increases the probability that the fire can be successfully brought under control. The capability to provide rotation for the attack teams is dependent upon manning levels and availability of personnel. This proposed criterion also captures the temperature limit for escape by unprotected personnel.

5.2.2 Equipment Failure Criteria

Failure criteria for electronic equipment due to thermal exposure is a conservative approach for predicting the impact of the fire environment on the vehicles and equipment stored in the WD and VSAs. The condition of the vehicles and equipment are critical to maintaining the mission capability of the ship. NSTM 555 offers such criteria in Table 555-1-8 and is reproduced below in Table 7.

Table 7. Thermal Effects on Electronics [2]

Temperature	Effects on Equipment
50 °C (120 °F)	Computers develop faults
150 °C (300 °F)	Permanent computer damage
250 °C (480 °F)	Data transmission cables fail

The temperature criteria identified in Table 7 should generally be viewed as soak temperatures that must be sustained for some critical duration to realize equipment failures. The landing vehicles and their associated weapons and equipment will have computerized components integral to their proper operation. Permanent damage to this type of equipment could significantly impact mission capabilities, and thus the 150 °C (302 °F) criterion was established as a reasonable failure point for maintaining mission capability as relating to the equipment stored in the WD and VSAs.

The vehicles and cargo may be able to sustain higher temperatures, in general. The other notable threat to the vehicles is the ignition of the tires. Section 4.2.2 addresses the ignition of tires located within the confines of pool fires, where flame contact or flame immersion is likely. Tires could be ignited or degraded from fires directly below. For example, fires on the MVSA level could ignite tires of vehicles located above the fire source on the UVSA level. The ignition temperature of rubber tires is on the order of 375 – 400 °C. A large, unmitigated, prolonged pool fire could generate steel deck temperatures of this magnitude.

5.3 CFAST Fire Modeling Analysis

This section describes the analysis performed to evaluate ventilation strategies in order to make specific heat and smoke management doctrine recommendations for the WD and VSAs. The recommended doctrine is summarized in Section 6.0 for applicable fire scenarios. Section 5.4 addresses the ventilation options and presents the analysis which supports the recommended doctrine, tactics, and procedures.

5.3.1 Modeling Approach

The approach used for modeling was to consider the impact of two primary factors on heat and smoke management: (1) the location of the fire; and (2) the availability and use of the mechanical, electrical and fire protections (MEFP) systems. The combination of various conditions for these two factors results in numerous fire scenarios and heat and smoke management configurations. By evaluating the impact of these fire scenarios on the WD and VSAs, the most effective method of heat and smoke management was determined. Table 8 summarizes the various fire locations and MEFP systems considered in the analysis.

Table 8. Summary of Analysis Variables

Fire Locations	Mechanical, Electrical, and Fire Protection (MEFP) Systems		
	AFFF Sprinklers	Stern Gate	Ventilation
Well Deck	Well Deck	Upper Gate	MVSA forward fans
MVSA	MVSA	Lower Gate	UVSA forward fans
UVSA	UVSA		WD aft fans
LVSA	LVSA		LCAC fans
	Other Areas		LVSA fans

The impact of the different fire and MEFP systems configurations were modeled using CFAST Version 3.1 [11]. CFAST was developed at the National Institute of Standards and Technology (NIST). CFAST is capable of modeling steady or non-steady burning conditions in multiple compartment configurations. In CFAST, the initiating fire is user-specified, but internally controlled by fuel and air supply rates. The model divides each compartment into two zones having a vertical relationship with respect to the development of the fire. The two zones are an upper zone which contains a hot layer and a lower zone, which is, at least initially, relatively cool.

The basic equations in CFAST describe the mass and energy transfer from zone to zone. Mass and energy transfer between the zones are produced by plumes, mixing of gases at vents (i.e., connections between compartments), radiation between layers, and heat transfer at the boundary surfaces. The prime equations in CFAST are based on the application of mass and energy conservation principles (control volumes) to homogeneous upper and lower gas regions in multi-compartment systems.

The CFAST model and its predecessor, FAST, have been extensively tested. The results have been reported in peer reviewed documents [12-16]. These analyses showed good agreement between CFAST (FAST in the case of Nelson and Deal) and fire tests for the estimation of temperature and interface layer. There are cases of variation between the tests and the predictions of the model. The upper layer temperatures predicted by CFAST are somewhat higher than experimental measurements, a conservative result. CFAST has been used for analytical purposes on numerous Navy related projects [14-20].

Input data for CFAST include the physical dimensions of the compartments, construction materials, the physical properties of these materials, vent openings, ventilation systems, fire growth rates, and the position of the specified fire.

The weapon hits of interest involve large Class B fires in the WD, MVSA or LVSA. The location of the fire impacts the conditions in the space, as well as the available access points for manual fire fighting efforts. The purpose of modeling various fire locations was to ensure that the effectiveness of a given heat and smoke management configuration was independent of fire location. Modeling different locations was also useful in identifying scenarios that may exceed the defined tenability limits.

The size of a fire in the WD or VSA depends on the cause of the fire (e.g., weapons hit, local ignition), quantity and configuration of fuel sources, types of fuel sources, and the available oxygen in the space. For the weapons hit of interest, the resulting fire sizes were determined in the TSS/BDRA. For this analysis, a rapidly growing fire having a peak heat release rate of 15 MW was assumed. The impact of smaller fires on the spaces will be less severe; however, the recommended doctrine would still be appropriate. Likewise, larger fires could develop in the space resulting in more severe conditions. However, the recommended doctrine still provides the most effective approach for heat and smoke management.

Although the use of the AFFF sprinkler systems is included in the recommended doctrine, it was assumed that the sprinklers would not be available for the purpose of evaluating various heat and smoke management configurations. The use of the sprinklers, if available, will improve the conditions in the WD and VSAs and should be used to the maximum extent possible to control the fire.

The LPD-17 stern gate is comprised of both an upper and lower gate. The impact of opening one or both gates on heat and smoke management was evaluated. Because the stern gate may not always be operable in a fire emergency, the impact of having the stern gate closed was also considered.

The WD and VSAs will be provided with several ventilation fans. The locations, capacities, and normal operating modes of these fans are described in Section 3.1. The modeling effort evaluated the combined use of these fans, as well as opening the stern gate, for heat and smoke management. Because all of the fans are reversible, the analysis considered multiple potential fan configurations to determine the most effective approach to controlling heat and smoke from a fire.

The goal of the doctrine was to provide as simple and straightforward method of mitigating the effects of a fire in the WD or VSAs as possible. A complicated doctrine involving multiple actions and/or system modifications was deemed to have limited benefit. Therefore, to the extent appropriate, using the normal operating modes of the MEFP systems was specified. Changes to the normal configurations was recommended only if substantial benefits were realized. For circumstances where more complicated doctrine is warranted, the feasibility of automating or semi-automating that doctrine should be investigated.

The modeling measures of performance used to evaluate the various ventilation configurations are primarily the upper layer temperature, the depth of the upper layer, and the visibility in the upper layer. This information characterizes the environment which results from the large Class B fire. It is this environment which will expose the equipment as well as determine the conditions that will face the responding DC teams. The upper layer is considered to be homogeneous, having a single representative temperature and soot concentration.

5.3.2 Modeling Assumptions and Limitations

The assumptions and limitations associated with the modeling activities have been summarized. These assumptions and limitations are largely reflections of those used in the TSS/BDRA [1].

(1) No fuel loading study was performed which addressed expected loading for the LPD-17. The fire sizes considered in this analysis were based on those determined in the TSS/BDRA.

(2) Fuel loading, fuel configuration, and fuel types are characteristics which synergistically determine the fire growth rate. In the absence of specific details, a linear growth rate was assumed with a heat release rate of 15 MW after 300 seconds.

(3) The analysis and simulations do not account for fire fighting activities or other mitigation effects. Fire suppression systems and mitigation activities can only be accounted for empirically, through superimposing estimated effects.

(4) The computer simulations using CFAST performed in this study do not account for pressure differentials (non-fire related) between compartments or between the ship and the weather. Such pressure differentials could, for example, result from wind effects.

(5) CFAST simulates the thermal effects of the fire on the modeled compartments. CFAST version 3.0.1 does not take into account any radiative interaction between common bulkheads of two separate compartments, except in the vertical direction.. Heat loss from one compartment to a second compartment by conduction is assumed to be lost to the outside ambient environment, except in the vertical direction. Secondary compartments can be heated by conduction, which is not reflected in the model.

(6) CFAST Version 3.0.1 does not consider the aspect ratio of the compartment with respect to smoke filling. Both narrow and square compartments are treated identically. This overlooks the smoke filling phenomena associated with long, narrow-type spaces. This phenomenon is not expected to be significant in the WD or VSAs.

(7) CFAST Version 3.0.1 assumes that all compartments are rectangular in shape. The dimensions of the selected compartments were adjusted accordingly for such situations.

The volume and height of the spaces, the two most important dimensions for this analysis, were maintained.

(8) The computer model only accepts one type of material and thickness for each compartment wall. This is especially important in situations where the material might bend or deform beyond its elastic limit (i.e., steel). Steel, 3.50 cm (3/8-in) thick, was chosen as the material for all compartment bulkheads and overheads.

(9) CFAST does not take into account stress fractures that might form in the steel after prolonged heat exposure. Heat loss through these cracks was assumed to be negligible.

(10) CFAST Version 3.0.1 assumes that the compartment is void of any objects. Heat loss to objects within the space is not accounted for.

(11) CFAST does not consider any effects that ship motion or change in ship orientation (i.e., list) may have on the fire or the fire growth and development.

5.4 Effects of Venting a Large, Battle Induced Fire

This section describes the technical evaluation of plausible ventilation strategies for large Class B fires. The input data files for the CFAST simulations and selected graphical output of the results can be found in Appendix A. The discussion of the simulations and results are categorized according to the type of space (i.e., open space and closed space). The open spaces are those which can be readily vented to weather, which includes the WD, MVSA, and UVSA. The LVSAs are enclosed and have no direct natural ventilation path to weather under steaming conditions (i.e., vehicle ramps are up and locked into position).

5.4.1 Venting of Open Spaces

Ventilation would reduce the heat and smoke buildup compared with providing no ventilation. Standard fire fighting doctrine for shipboard fires does not typically involve ventilating the space. Normally, a space is sealed to starve the fire of oxygen, resulting in a reduced fire size and compartment temperature. An analysis of the available air in the large volume of the WD and VSAs indicated that sufficient oxygen is available to support large fires (e.g., tens of megawatts) for prolonged periods of time. For example, a 15 MW fire can be sustained in the WD or MVSA for approximately 40 minutes before the heat release rate begins to decline due to a reduction in oxygen. This assumes that the WD, MVSA and UVSA are tightly secured. The fire decreases slowly and drops to just over 2 MW after 2 hours. While a reduction in heat release rate could be expected after 40 minutes for a sealed compartment scenario, large fires could be supported indefinitely when large openings to the weather are created due to weapon effects. Large openings to the weather can support large fire sizes over longer durations than a 40 minute time period. This would result in significantly higher temperatures.

Figures 8 and 9 illustrate the effects on temperature and heat release rate of venting the WD, MVSA, and UVSA by opening the stern gate in order to vent a WD fire. A 15 MW fire was simulated in the WD at deck level. Under the natural–ventilation–only configuration (i.e., no mechanical ventilation) the modeling results indicate peak temperatures exceed 250 °C (482 °F) for the WD and exceed 200 °C (392 °F) in the UVSA and MVSA areas. Thermal exposures are predicted to be above 150 °C (302 °F) for more than an hour in the WD and for approximately ¾ hour in the MVSA/UVSA. Figure 9, which shows the upper layer interface height, indicates that the upper layer would be close to the deck level for each space. Everything in the WD, MVSA, and UVSA would be soaking in very hot smoke. Based on the established tenability and damageability criteria, extensive damage of the vehicles and cargo would occur throughout these spaces and fire fighters may not be able to access the WD for some time. The no-ventilation case shows that the fire begins to become oxygen limited after approximately 40 minutes; however, the fire is still burning at over 2.0 MW after 2 hours.

With the stern gate open, temperatures in the WD remain below 150° C, and temperatures remain below 110 °C in the MVSA and UVSA even after 2 hours of sustained burning at 15 MW. The upper layer interface height indicates that the smoke and heat would never descend to the MVSA level. The smoke and heat would be confined to approximately 8.5 m (27.9 ft) above the deck of the WD. These thermal exposures are below the established tenability limits for fire fighters and the damageability criterion for vehicles and cargo. Opening the stern gate allows heat and smoke to discharge out the stern of the ship, significantly reducing the accumulation of heat and smoke as well as limiting the exposure to the vehicles on the UVSA as well as the access points in the WD. These data support the use of natural venting to reduce the heat and smoke accumulation.

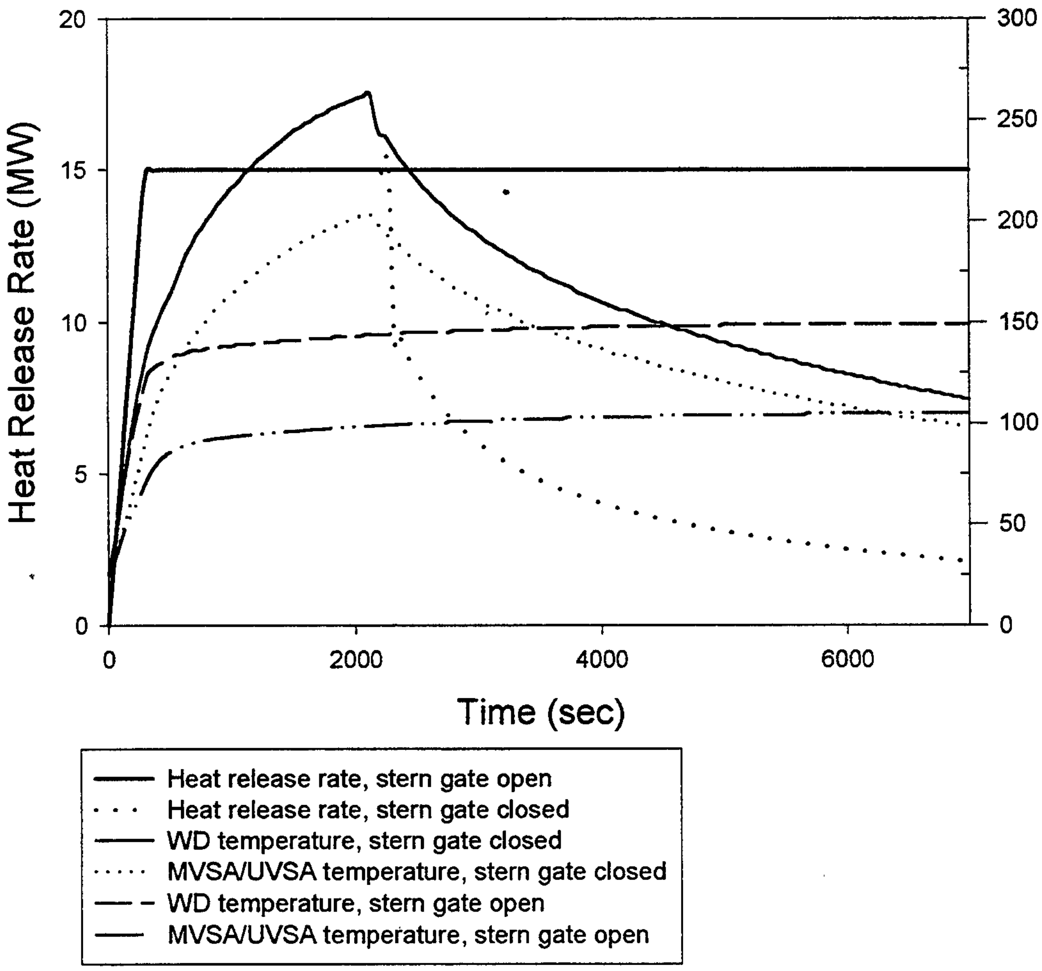


Fig. 8 - The effect of opening the stern gate on temperatures and heat release rates for a fire in the WD

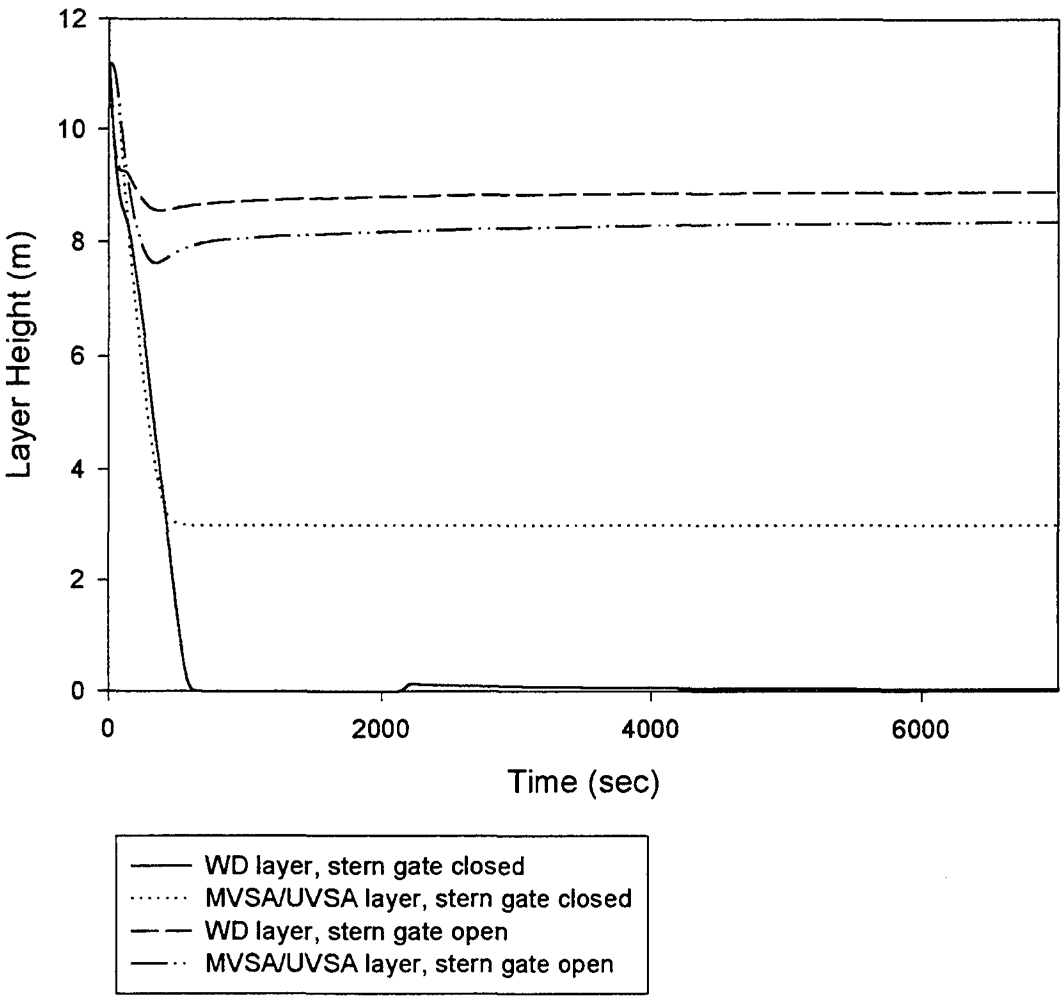


Fig. 9 - The effect of opening the stern gate on smoke layer interface height for a fire in the WD

Figures 10 and 11 depict the relative impact of opening the stern gate for fires located in the MVSA. Figure 10 shows that there is not a large reduction in temperature of the hot smoke layer between the closed scenario and the case where natural ventilation is provided by opening the stern gate. Figure 11 does demonstrate the benefits of natural venting on the hot layer interface. The layer extends to the deck for both the WD and MVSA when the stern gate remains closed. When the stern gate is opened, the layer interface remains approximately 9.0 m above the WD deck. Given a large fire in the MVSA, the depth of hot smoke will be sharply reduced as the majority of hot smoke is allowed to vent to weather through the stern gate.

The computer modeling results demonstrate that providing natural ventilation to the WD, MVSA, and UVSA by opening the stern gates is an effective technique for limiting the buildup of heat and smoke. Regardless of the fire location (WD, MVSA/UVSA), the smoke layer is maintained at levels notably higher than where no ventilation is provided. This will limit the damage to vehicles and cargo. The higher upper layer interface heights also allow for fire fighter access at lower elevations in relatively cool conditions. Although the model results indicate that the hot gas layer will be maintained 8-9 m above the WD deck with the stern gate open, in reality, the hot gas layer elevation will not likely be uniform over the large area. Local effects will cause the gas layer to descend in some areas and may cause damage to contents. However, opening the stern gate clearly offers an advantage as opposed to not opening the gate. If the stern gate is not opened, without mechanical ventilation, all vehicles and cargo will be exposed and potentially damaged.

Recommendation

The first recommended action with respect to ventilating the WD, MVSA, and UVSA areas is to open the stern gate. Opening the stern gate allows heat and smoke to vent out the stern of the ship. Depending upon the size and location of the fire, this action above may be sufficient to control the temperature of the smoke in these spaces within the established tenability and damageability criteria. The effectiveness of the stern venting can be maximized by insuring that the ship is headed into the wind. The purpose of this action is to create a negative pressure with respect to the stern of the ship. An additional benefit is that exhausted gases and smoke will not be ingested into the ship.

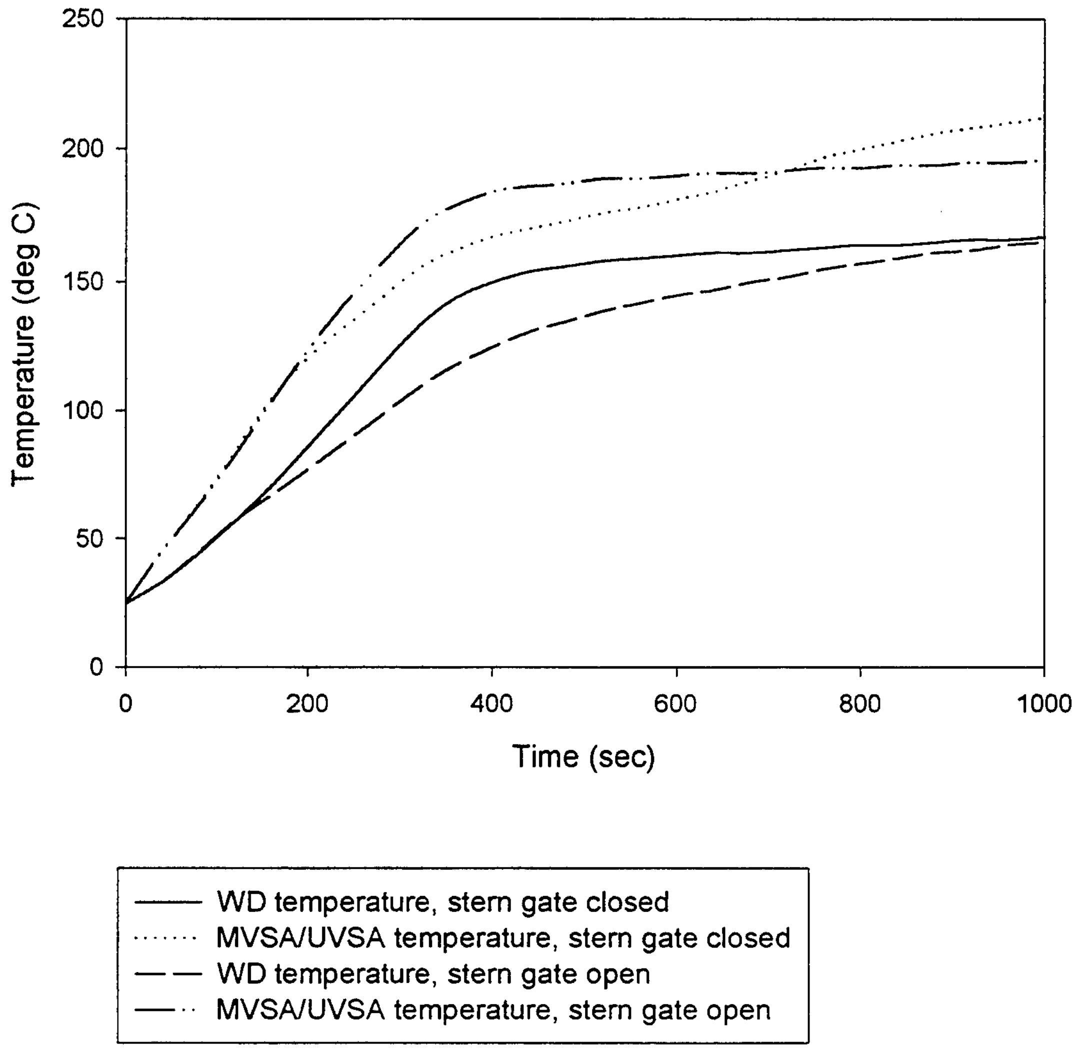


Fig. 10 – The effect of opening the stern gate on upper layer gas temperatures for a fire in the MVSA

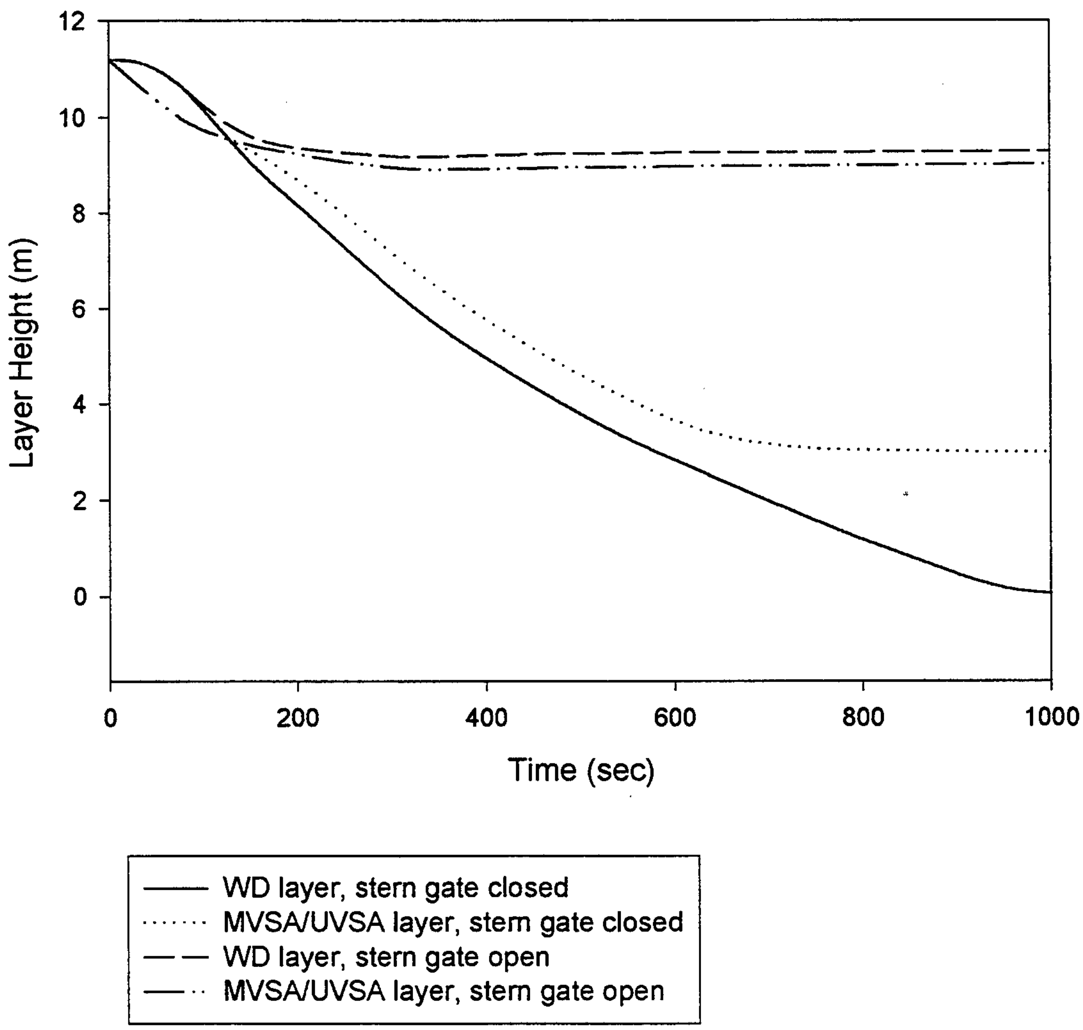


Fig. 11 – The effect of opening the stern gate on the smoke layer interface height for a fire in the MVSA

5.4.2 Venting Closed Spaces

The design configuration for the LVSA Forward and Aft compartments results in compartments with little opportunity to provide natural venting. A single escape trunk and vehicle ramp (movable) provide the only openings to each of these spaces. It is not feasible to use the vehicle ramp as a natural venting option for doctrine development for the following reasons:

- The vehicle ramps are secured in the up position unless load-out or unload activities are underway;
- Equipment or vehicles may be stored on top of the ramp when in the up position; and
- Blast overpressures induced by weapons detonation can jam ramps in place.

The limitations associated with the ability to access and/or ventilate the LVSA spaces are very similar to machinery spaces. The fire threats (Class B) are also similar. Based on the characterization of the LVSA spaces as similar to machinery spaces, existing doctrine and full scale fire test data were used as a foundation for the fire fighting guidelines and smoke/heat management doctrine for these spaces.

NSTM 555 fire fighting doctrine provides both general guidance regarding ventilation changes as well as specific guidance for machinery space ventilation. This guidance can be summarized in the following manner: ventilation should be secured to machinery spaces when spaces are abandoned or when there is an out-of-control Class B fire. The ventilation should subsequently be set negatively for the machinery space containing the fire in support of fire fighting activities. Negative ventilation in the machinery space is accomplished by providing the highest exhaust ventilation rate with either no or low supply ventilation rates. This approach is based on machinery space fire testing [24]. Air supply is secured so that a fire does not grow while personnel escape and prepare for fire fighting reentry. The space is then exhausted during reentry to aid in fire fighting even though this ventilation may support additional burning.

The impact of maintaining the LVSA spaces in a closed condition was evaluated for large Class B fires. Figures 12 depicts the heat release rates and temperatures in the LVSA for a 15 MW fire, based on the modeling results. The results demonstrate that if the space is sealed up and ventilation turned off, the

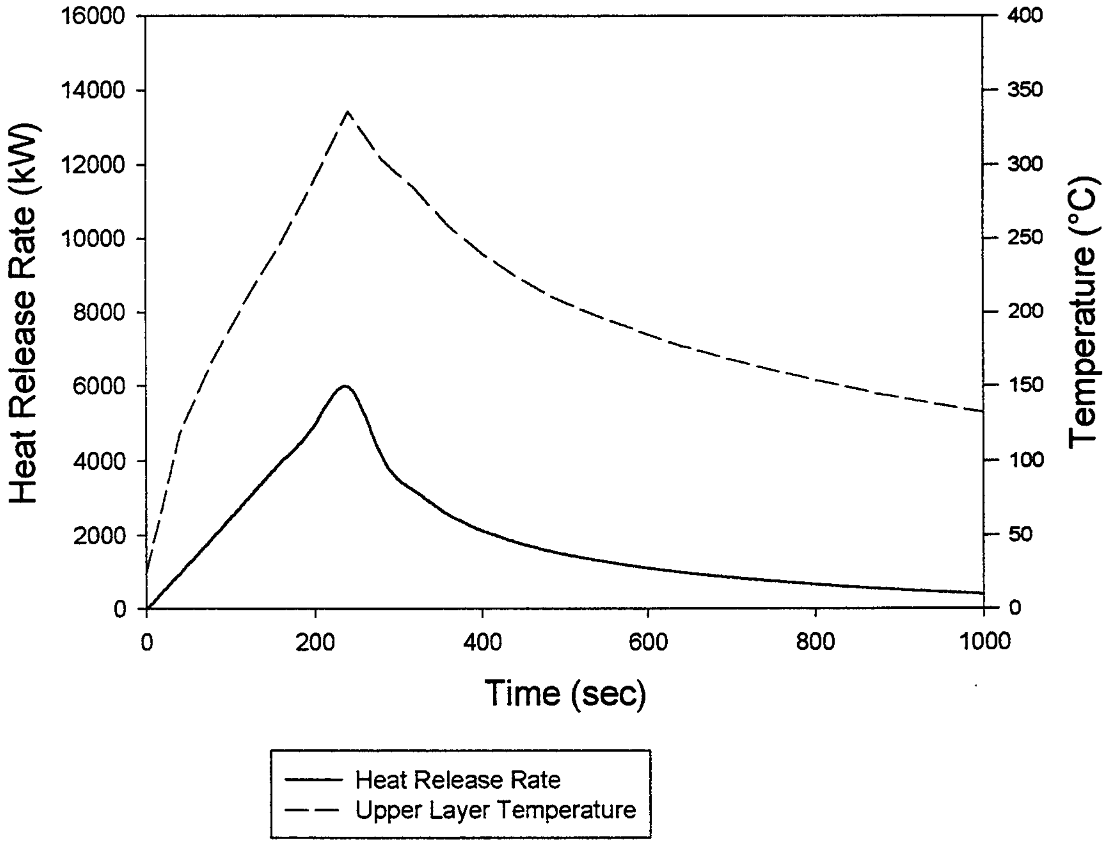


Fig. 12 – Upper layer gas temperatures and heat release rate for a fire in the LVSA with no mechanical or natural ventilation

fire will become ventilation limited within 4-5 minutes. As a result, the heat release rate of the fire rapidly decreases resulting in reduced temperatures in the space. By sealing the space, temperatures can be maintained below 150° C (272°F), once the space cools from the initial fire exposure.

The results for securing ventilation can be compared with results that reflect continuous ventilation of the LVSA space. If the ventilation supply is left on, the fire will continue to burn at its peak heat release rate, as shown in Figure 13. As a result, the temperature in space can exceed 500 °C (902 °F) within 10-15 minutes, also shown in Figure 13. The threshold temperature for flashover is typically on the order of 500-600 °C (902-1082 °F). Therefore, with the ventilation supply on, flashover of the space is a plausible event.

The conclusions of the full scale test report stress the benefit of ventilating the space in a negative manner where the exhaust rate is greater than the supply rate [24]. Fleet Doctrine evaluation workshops where fire fighting strategies have been performed against real fires in a controlled environment have demonstrated the effectiveness of active venting/desmoking in improving access/entry to spaces containing fires [25]. Other Fleet Doctrine testing supports this conclusion [10, 26, 27]. More recent fleet doctrine evaluations for machinery spaces protected with water mist systems reconfirmed the benefit of activating ventilation systems prior to reentry [28]. These tests indicates that in order for fire fighters to successfully access or re-enter spaces like the LVSAs, the space containing the fire must be vented.

One aspect not anticipated in the NSTM 555 doctrine or the full scale tests/doctrine evaluations is the weapons hit effects. Depending upon the level of damage sustained to the LVSA and the extent of vent opening to either the weather or the WD the effectiveness of the doctrine recommendations may be compromised. The On Scene leader will have to use judgment in dealing with weapons effect-related fires in the LVSA spaces. Depending upon the size of the vent area created by the weapon, securing ventilation and buttoning-up the LVSA may not significantly reduce the fire size. In this case, indirect fire fighting techniques may be the most effective to reduce the fire size.

Recommendation:

In the event of a large Class B fire in a LVSA space which either results from a weapon hit or precipitates the abandonment of the space, the first action should be to secure ventilation to the space and close any openings. Ship's personnel should prepare for direct fire fighting activities or commence with

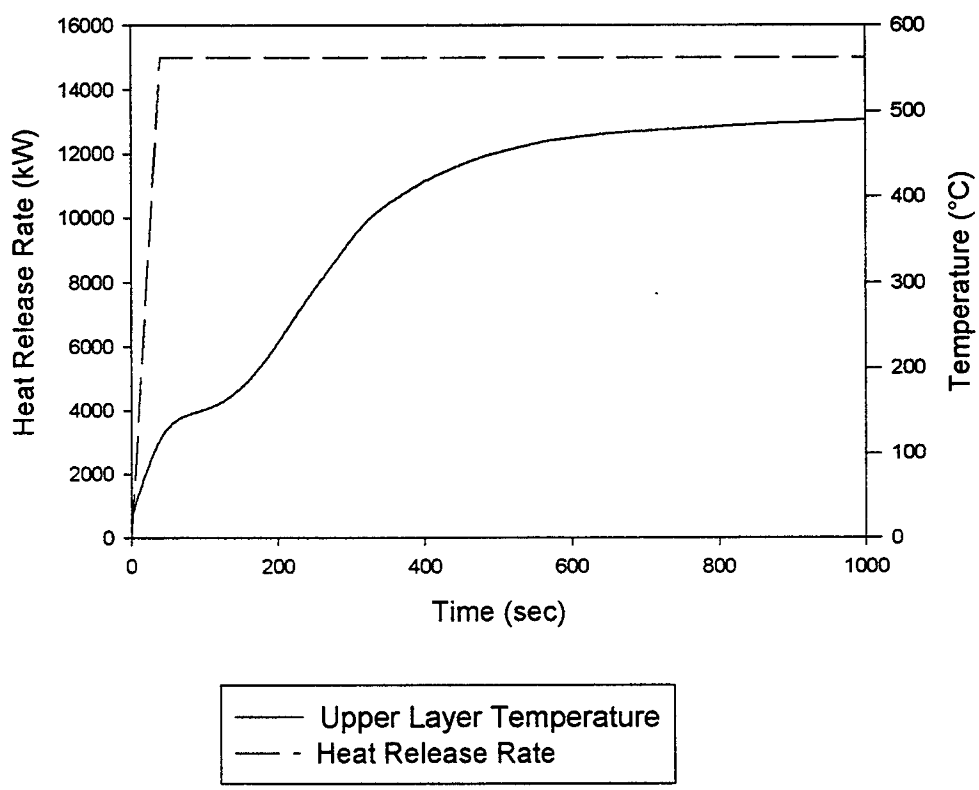


Figure 13 – Upper layer gas temperatures and heat release rate in the LVSA for a fire in the LVSA with forward supply

indirect fire fighting techniques if direct fire fighting tactics are determined to be unplausible. If indirect fire fighting activities are initiated, they should continue until access/re-entry is possible. Negative ventilation for the LVSA space containing the fire should be set prior to access/re-entry. The most appropriate ventilation management strategy for LVSA fires is situation dependant and the On Scene leader will have to exercise judgement in determining the most prudent course of action. Factors to consider are the size of the fire, extent of venting created by weapons effects, condition of vehicle ramp (up or down) and extent of indirect fire fighting capabilities available. Heat and smoke management for the LVSA spaces is situation dependent and the On Scene leader in consultation with the DCA or Repair Party Leader will have to make a judgment decision.

5.4.3 Effects of Mechanical Venting on Open Spaces

The effects of utilizing mechanical ventilation to assist in smoke and heat management for large fires in the WD and open VSAs (MVSA, UVSA) were evaluated. The assessment logically breaks down into two scenarios; one scenario where the stern gate can be opened and one scenario where the stern gate cannot be opened. Each scenario is discussed below.

5.4.3.1 Stern Gate Open

The ability to have the stern gate open is important in terms of providing natural ventilation as discussed in Section 5.4.1. The benefits of opening the stern gate were improved with the augmentation of mechanical ventilation, as supported by the following analysis. The general strategy was to push as much heat and smoke out the top portion of the stern gate while cooler air from weather enters through the lower portion of the stern gate. Several ventilation elements were varied to characterize their individual contribution in reducing the heat buildup in the open spaces. These elements included:

- Opening the bottom stern gate in addition to the top stern gate;
- Operating the forward supply fans at the MVSA and UVSA levels;
- Operating the aft WD exhaust fans; and
- Operating the LCAC fans.

These configurations were evaluated, using the 15 MW Class B fire scenario.

Figures 14 through 17 illustrate the impact of augmenting the stern gate natural ventilation with mechanical ventilation. The basic strategies reflected in these figures are as follows:

- Stern gate natural ventilation only;
- Augmentation of natural ventilation with general VSA ventilation (forward supply at MVSA and UVSA levels with aft exhaust in the WD);
- Natural ventilation enhanced with maximum supply capabilities (forward supply at MVSA and UVSA levels in addition to LCAC supply fans); and
- Natural ventilation with general VSA ventilation and LCAC supply fans (forward supply at MVSA and UVSA levels, aft WD exhaust, and LCAC supply fans).

Figures 14 and 15 present the conditions in the MVSA/UVSA areas for the fire location in the MVSA. Figures 16 and 17 depict the conditions in the WD area for the same simulations. The results demonstrate that the augmentation of mechanical ventilation enhances the cooling effects and aids in exhausting the heat and smoke via the open stern gate. Operating only the forward MVSA and UVSA supply fans (no aft WD exhaust) improves conditions over the natural-ventilation-only approach and provides the greatest portion of the achieved temperature reduction. The maximum reduction in heat accumulation (although not much greater than MVSA/UV SA forward supply only) is realized when the forward supply fans, aft WD exhaust fans and the LCAC supply fans are operated. For fires in the MVSA, temperatures can be maintained below 150 °C (302 °F) when using this optimum configuration.

The 15 MW Class B fire was also simulated in the WD for the same four ventilation configurations that were evaluated for fires in the MVSA area. The results are illustrated in Figures 18 and 19. Again, the most effective configuration is augmenting the natural ventilation with the forward supply fans at the MVSA and UVSA levels, aft WD exhaust, and LCAC fans in supply mode. For fires in the WD, which are bounded by the 15 MW Class B fire, this optimal ventilation configuration maintains temperatures below 100 °C (212 °F). Therefore, smoke and heat accumulation from large Class B fires in either the WD or MVSA can be managed to maintain tenable conditions that facilitate manual fire fighting efforts as well as limiting thermal damage to vehicles and cargo.

The use of LCAC supply fans was investigated in furthering the exhaust of heat and smoke. Figures 18 through 19 portray the results for fires in the WD under the four ventilation configurations. The LCAC fans in supply mode reduce the WD temperatures by approximately 20 °C over the configuration where the forward supply fans and aft exhaust are used. The layer does drop an additional

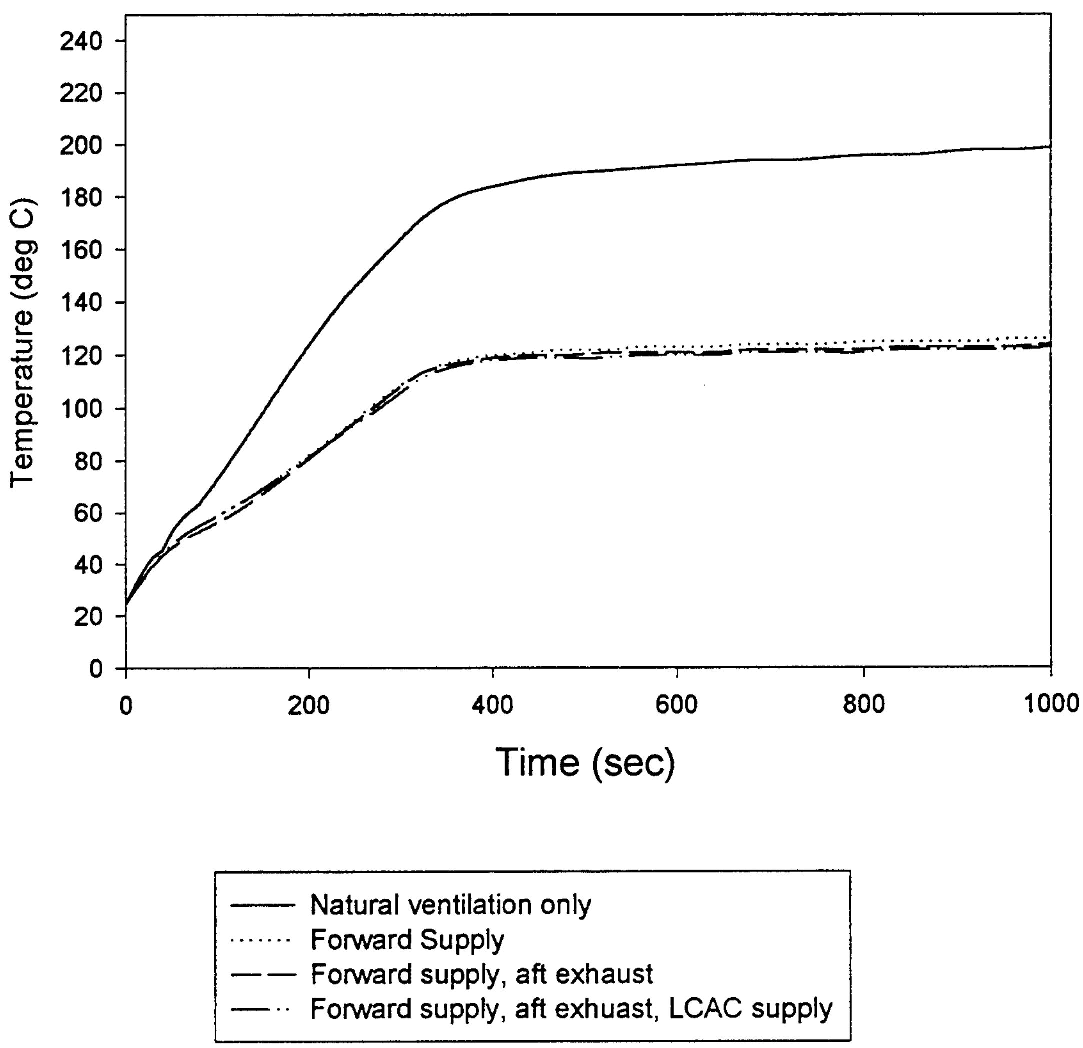


Fig. 14 – The effect of varying mechanical ventilation conditions with the top stern gate open on the MVSA/UVSA upper layer gas temperatures for a fire in the MVSA

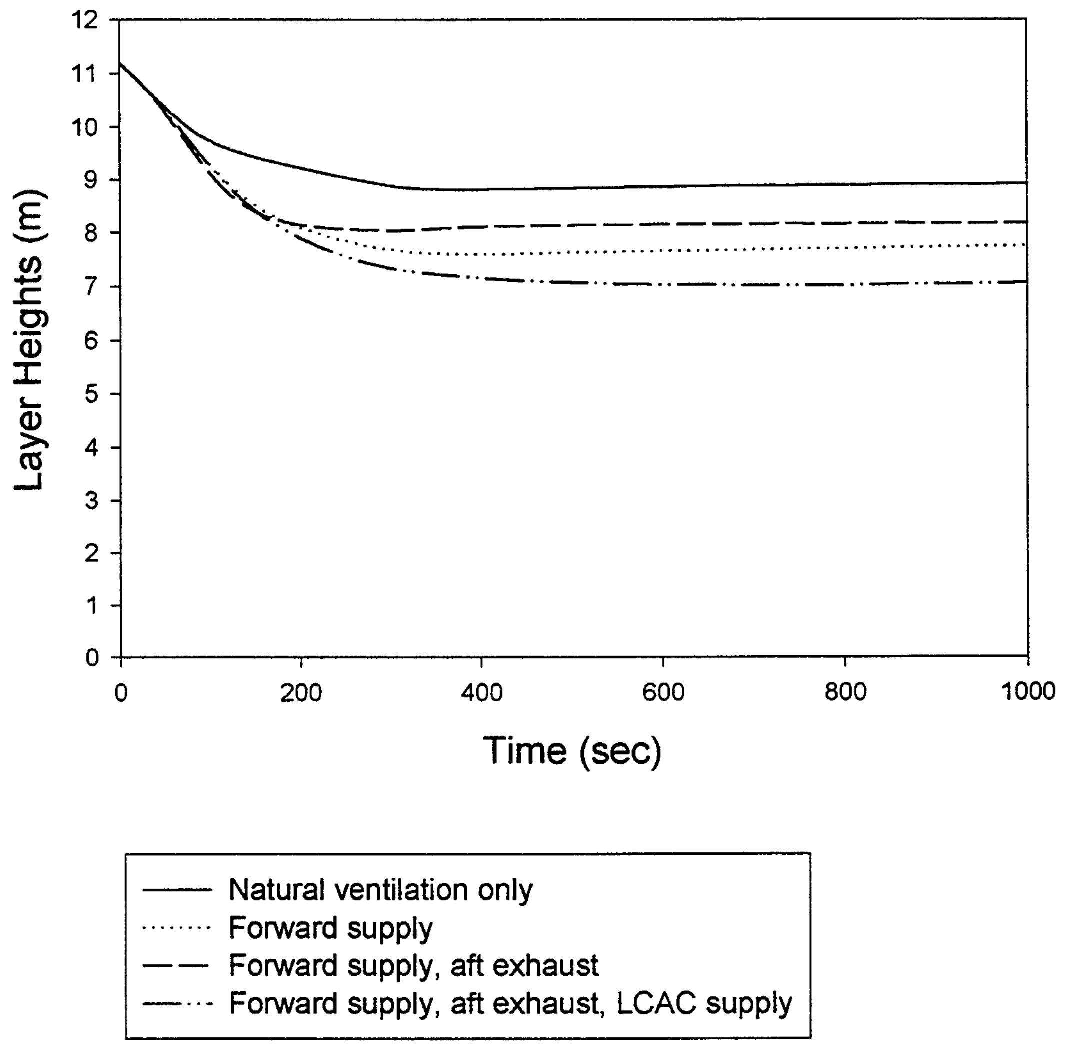


Fig. 15 – The effect of varying mechanical ventilation conditions with the top stern gate open on the MVSA/UVSA smoke interface heights for a fire in the MVSA

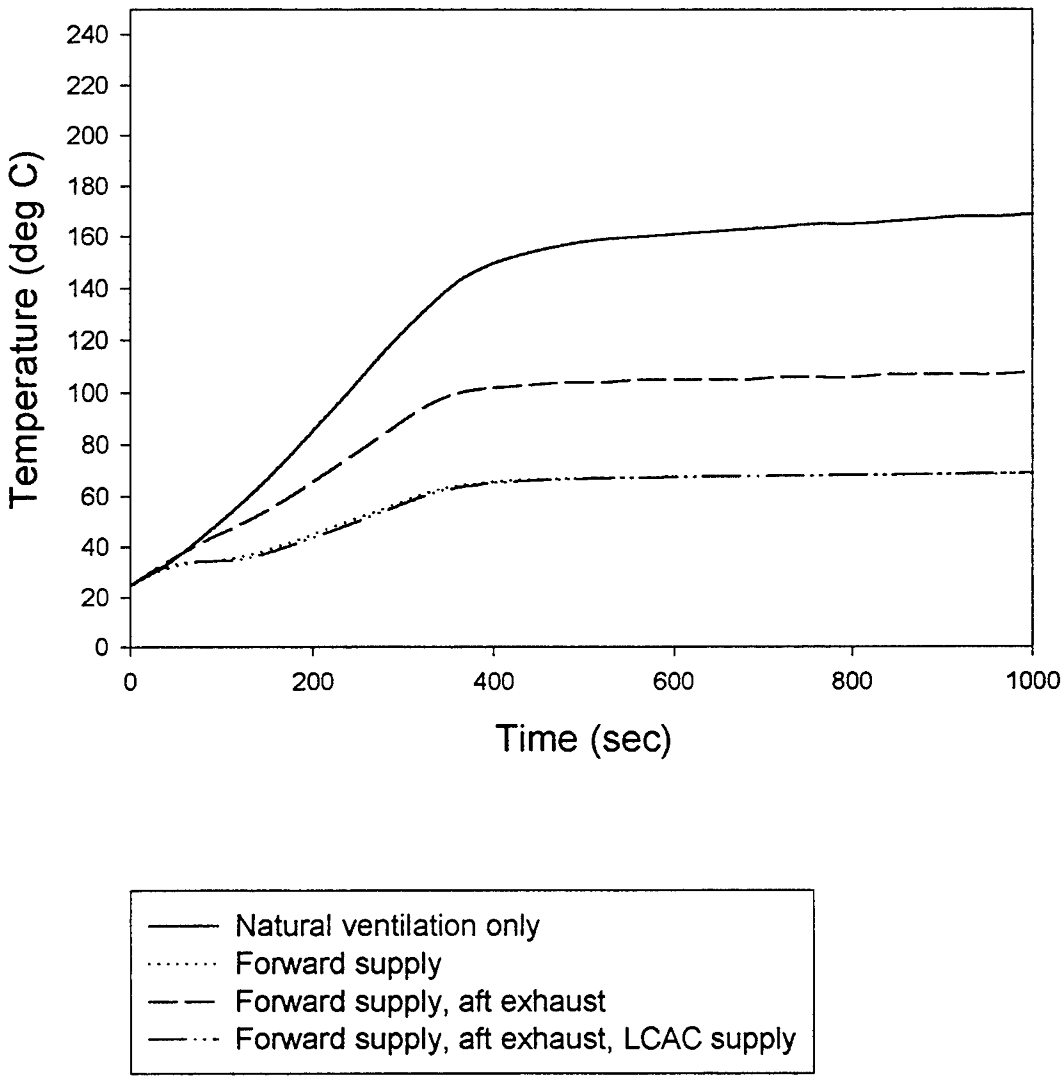


Fig. 16 – The effect of varying mechanical ventilation conditions with the top stern gate open on the upper layer gas temperature in the WD for a fire in the MVSA

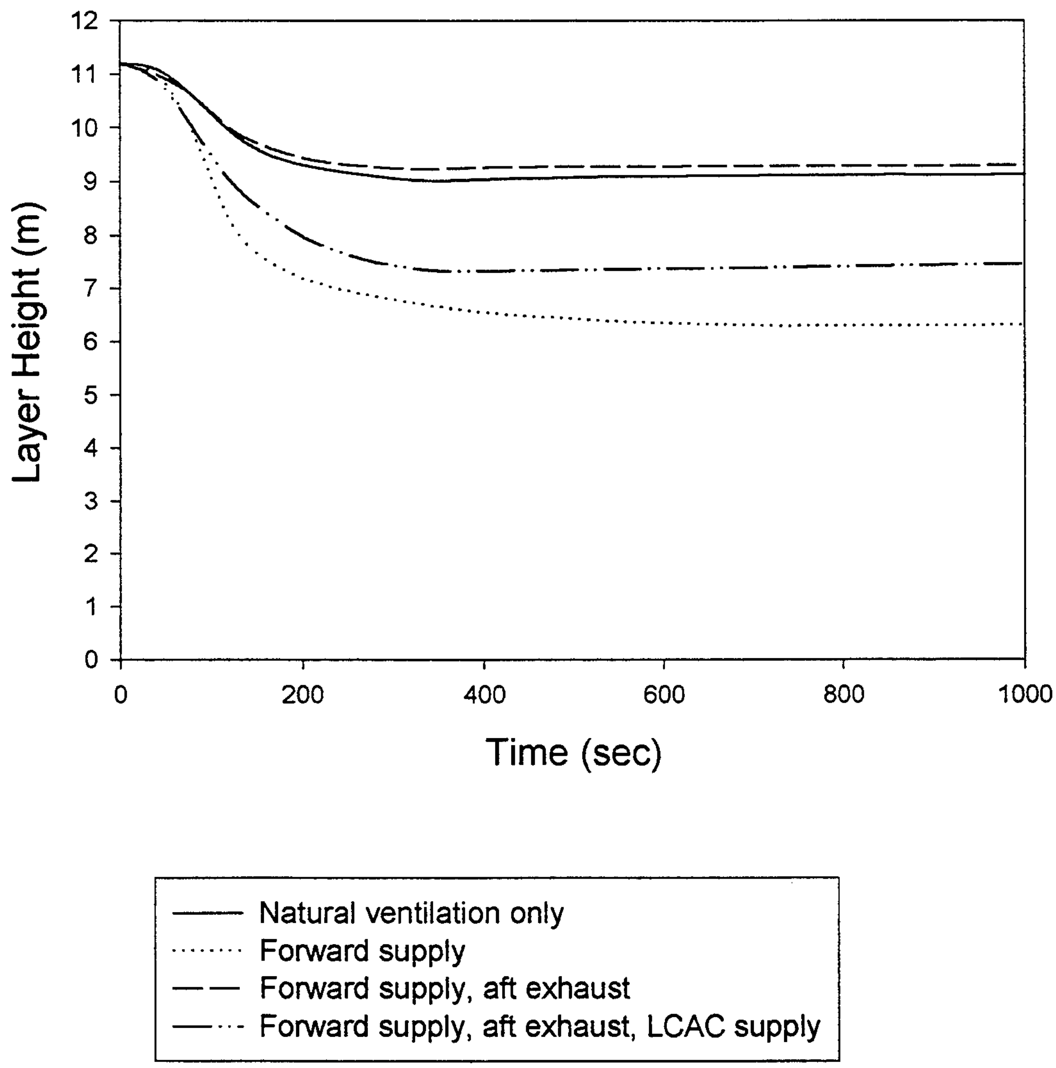


Fig. 17 – The effect of varying mechanical ventilation conditions with the top stern gate open on the smoke layer interface height in the WD for a fire in the MVSA

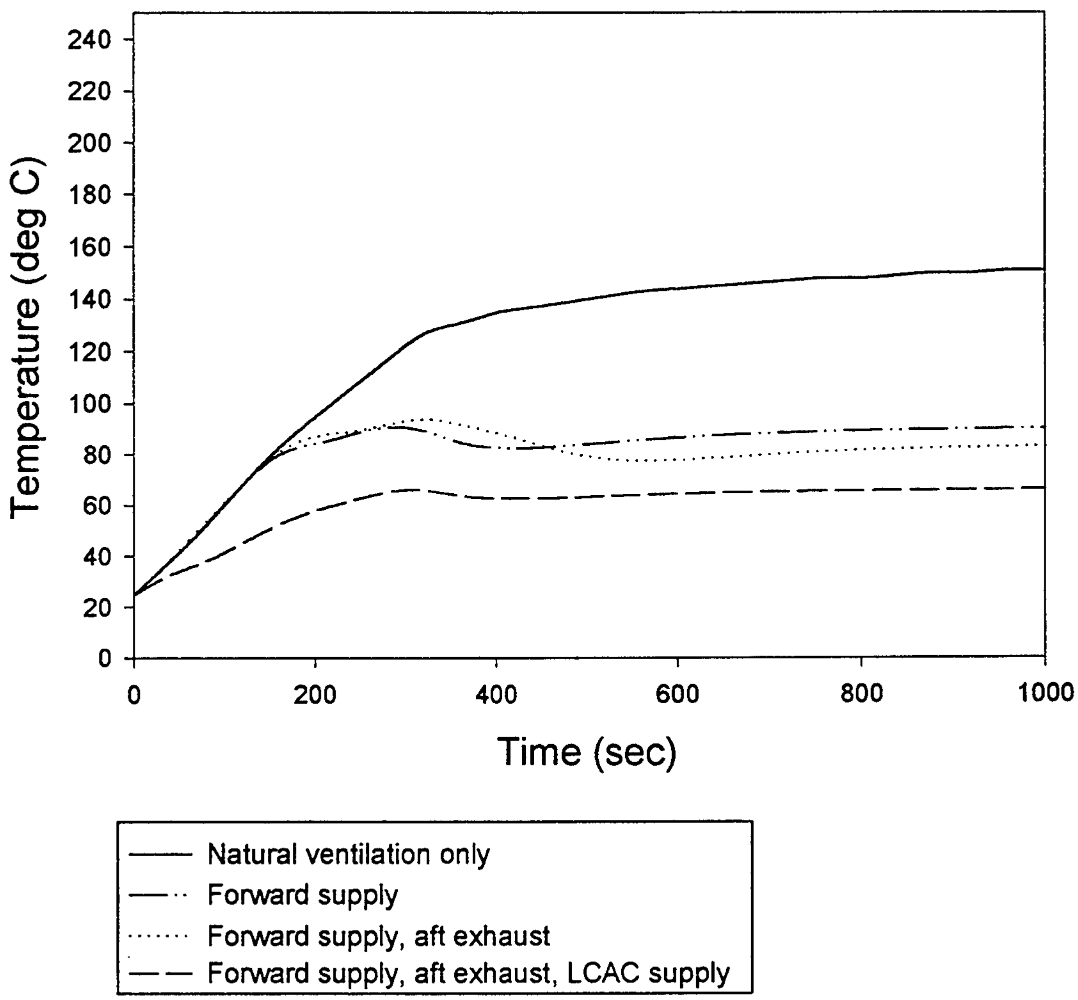


Fig. 18 – The effect of varying mechanical ventilation conditions with the top stern gate open on upper layer gas temperatures in the WD for a fire in the WD

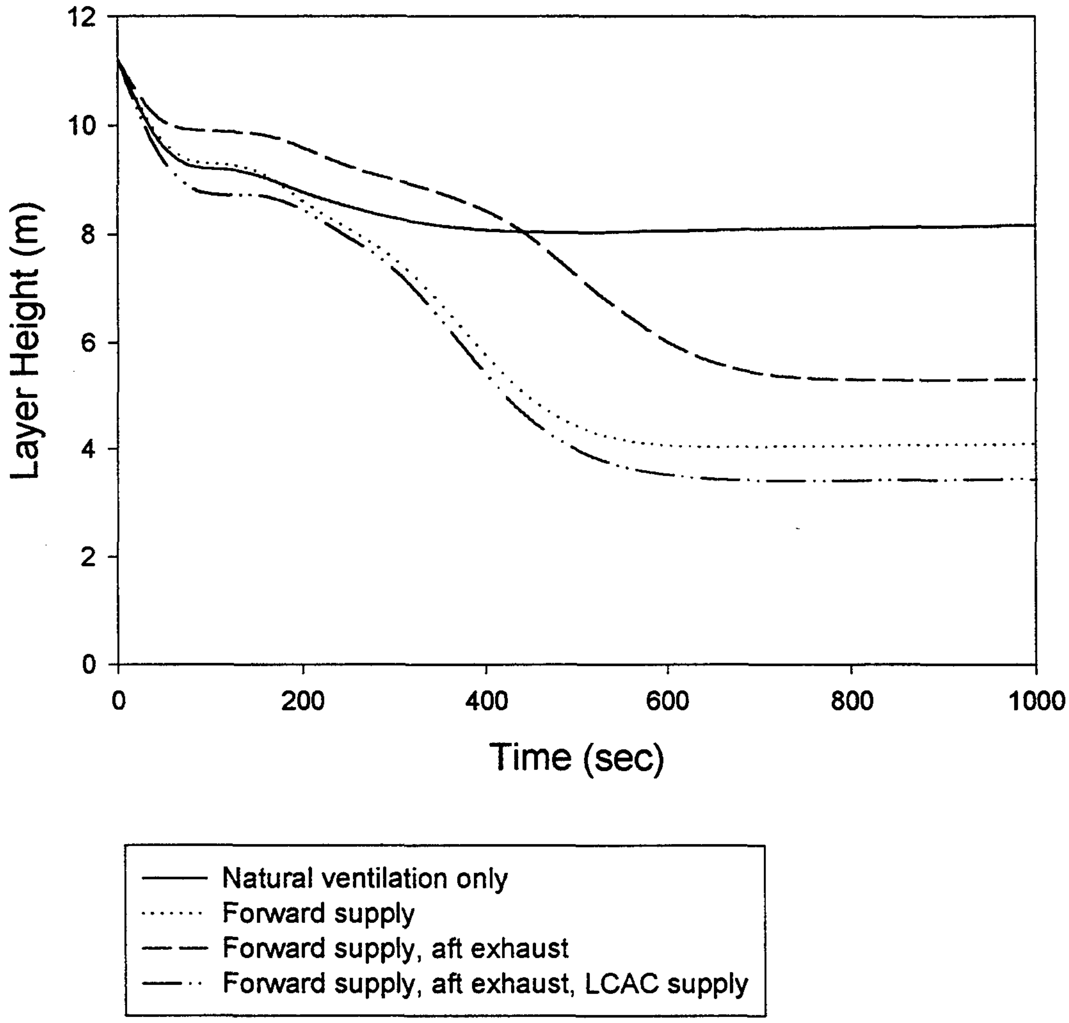


Fig. 19 – The effect of varying mechanical ventilation conditions with the top stern gate open on the smoke layer interface height in the WD for a fire in the WD

2 meters over the same case. However, the visibility through the smoke layer should not impede fire fighting activities after a time according to Figure 20.

The need to open the bottom stern gate in addition to the top stern gate was evaluated. Fires were simulated in both the WD and MVSA areas. The impact of opening the bottom stern gate compared with leaving it shut was assessed under the optimum forced ventilation configuration. Based on the modeling results, it was found that opening the lower stern gate has limited impact on the heat and smoke venting. Figures 21 and 22 illustrate the temperatures for fires in the WD and MVSA, with and without opening the lower stern gate. As indicated, the temperature difference is negligible for the two different configurations. Based on the limited impact coupled with the fact that opening the lower gate may require resources that could be used elsewhere, opening of the bottom stern gate is not an integral element of the recommended heat and smoke management doctrine.

In general, the effectiveness of natural ventilation augmentation is based on the ability of the mechanical ventilation to cool the space by diluting the hot gas layer and increasing the exhaust rate of heat and smoke out of the stern gate. However, due to the large volumes of air that are being introduced into the space, the smoke layer expands and descends to the deck of the MVSA and UVSA. Because the temperatures are relatively cool, a smoke layer occupying the entire volume is not a significant problem. The smoke is diluted, and therefore, will not severely reduce visibility. Based on the temperatures and visibility of spaces, manual fire fighting can likely be performed.

Recommendation

Assuming that the top stern gate can be/is opened, the recommended doctrine is the use of all of the ventilation capabilities associated with the WD, MVSA, and UVSA in normal mode. The forward supply fans at MVSA and UVSA levels should be operated as soon as possible. The aft WD exhaust fans should be activated. Both LCAC supply fans should be turned on. Contingencies are simple in that it is beneficial to run any combination of the mechanical ventilation components.

5.4.3.2 Stern Gate Closed

The ability of mechanical ventilation to control the environment when the stern gate is not operational or remains closed was evaluated. Figures 23 through 26 depict the conditions in both the WD

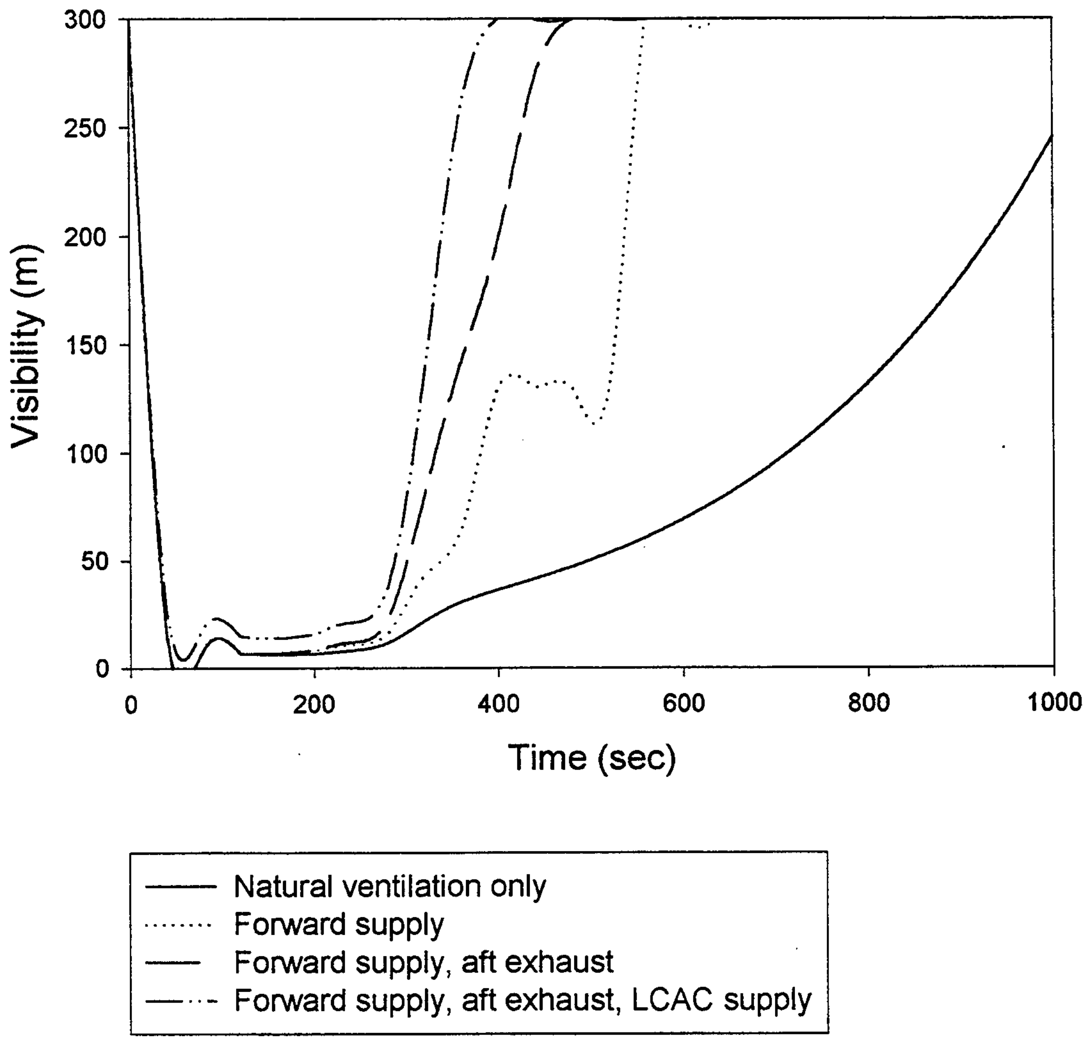


Fig. 20 – The effect of varying mechanical ventilation conditions on the visibility in the WD for a fire in the WD and the top stern gate open

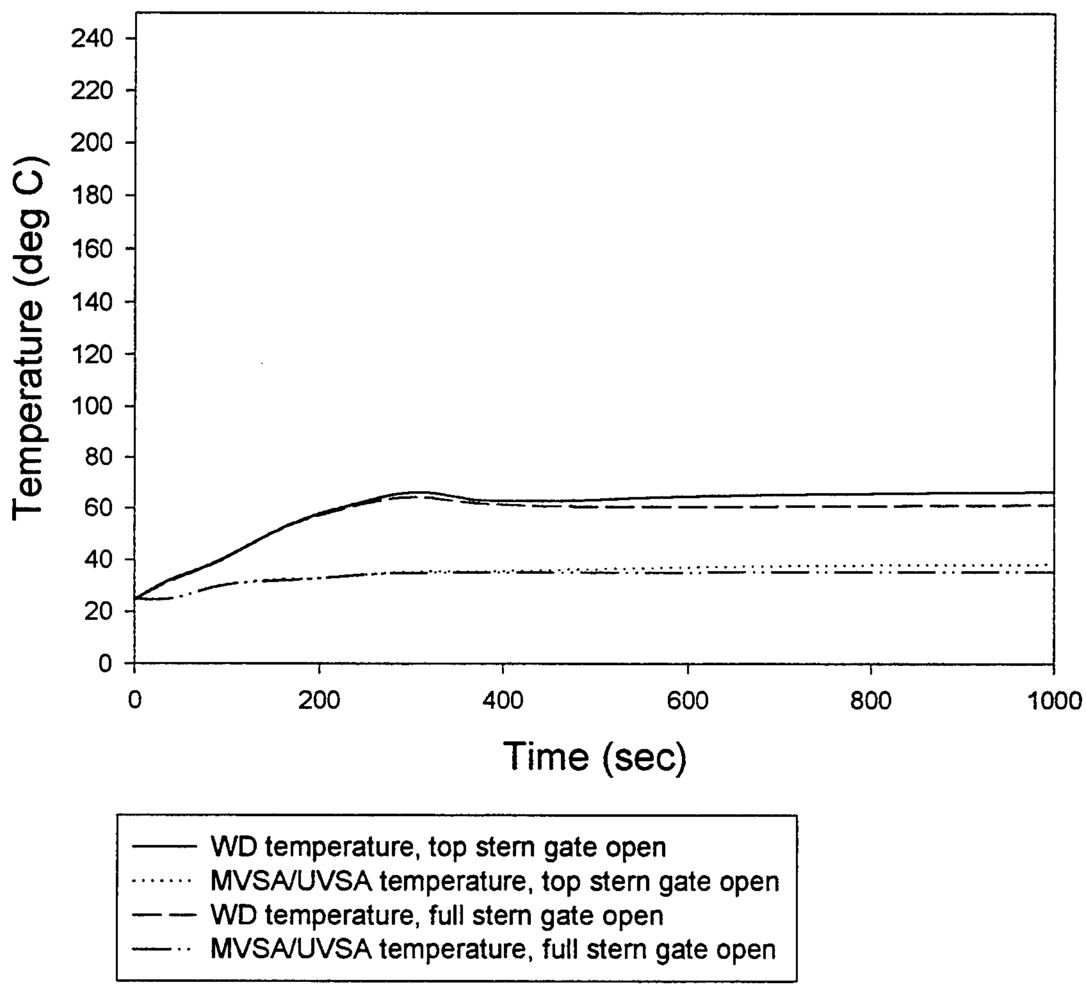


Fig. 21 – The effect of varying natural ventilation conditions on the upper layer gas temperatures for a fire in the WD with forward supply, aft exhaust, LCAC supply

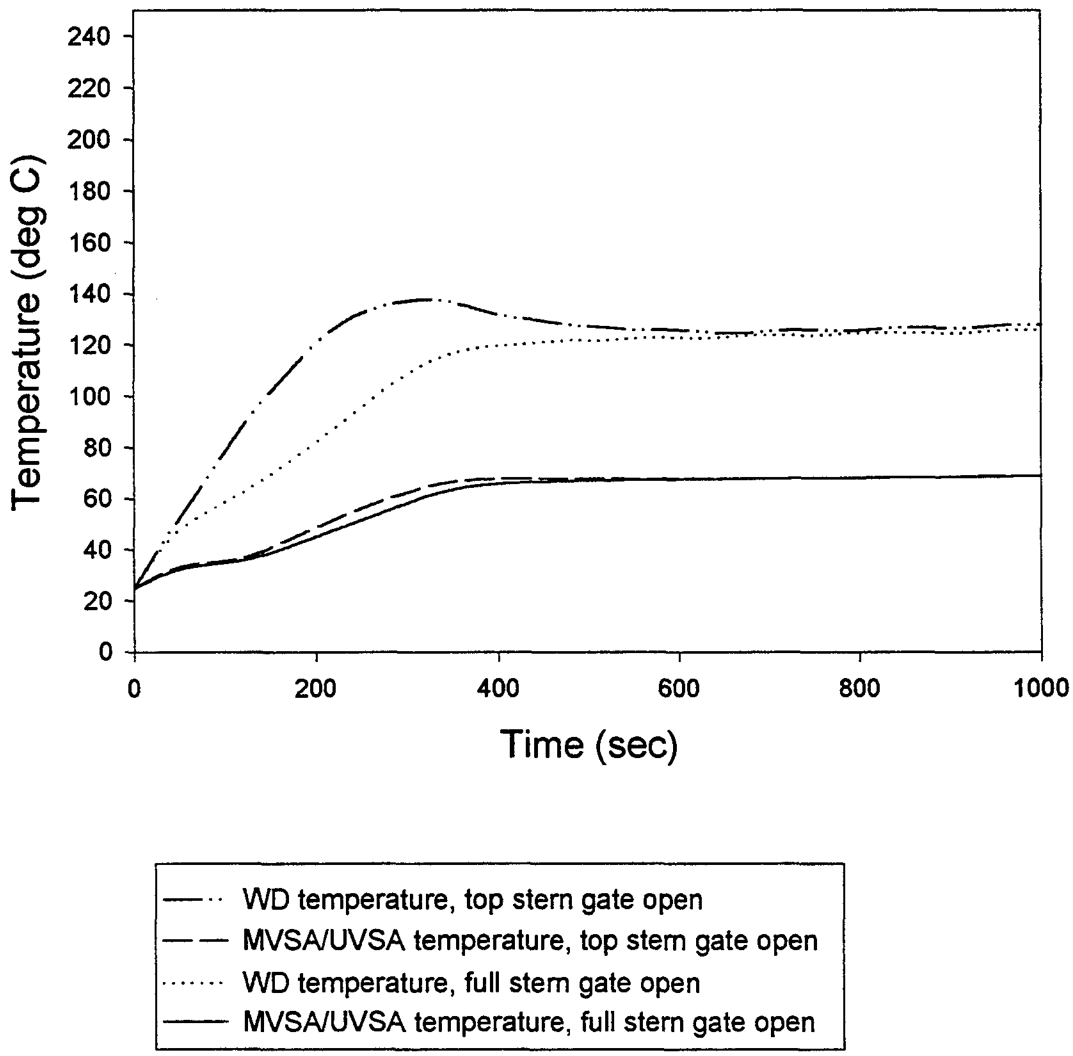


Fig. 22 – The effect of varying natural ventilation conditions on the upper layer gas temperatures for a fire in the MVSA with forward supply, aft exhaust, LCAC supply

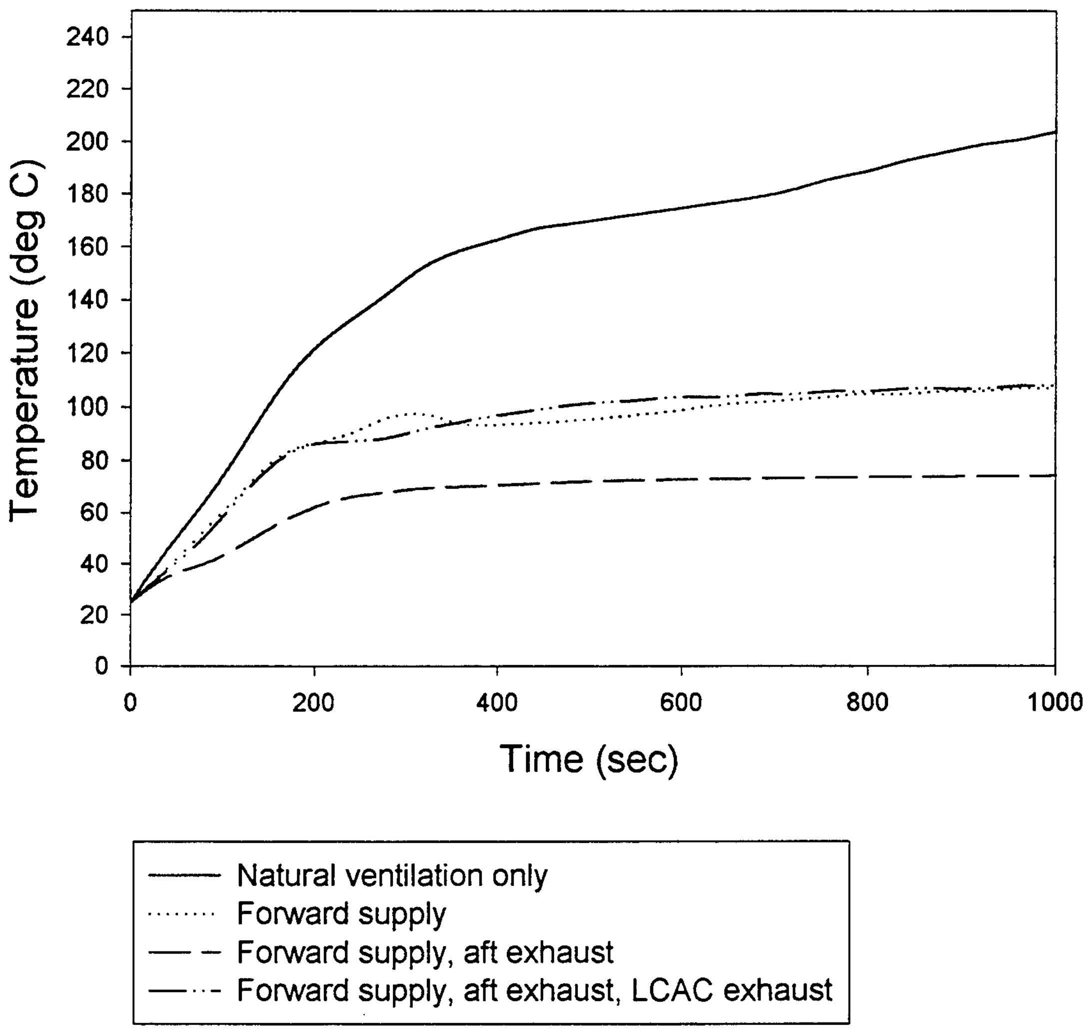


Fig. 23 – The effect of varying mechanical ventilation conditions on the upper gas layer temperatures in the WD for a fire in the WD with the stern gate closed

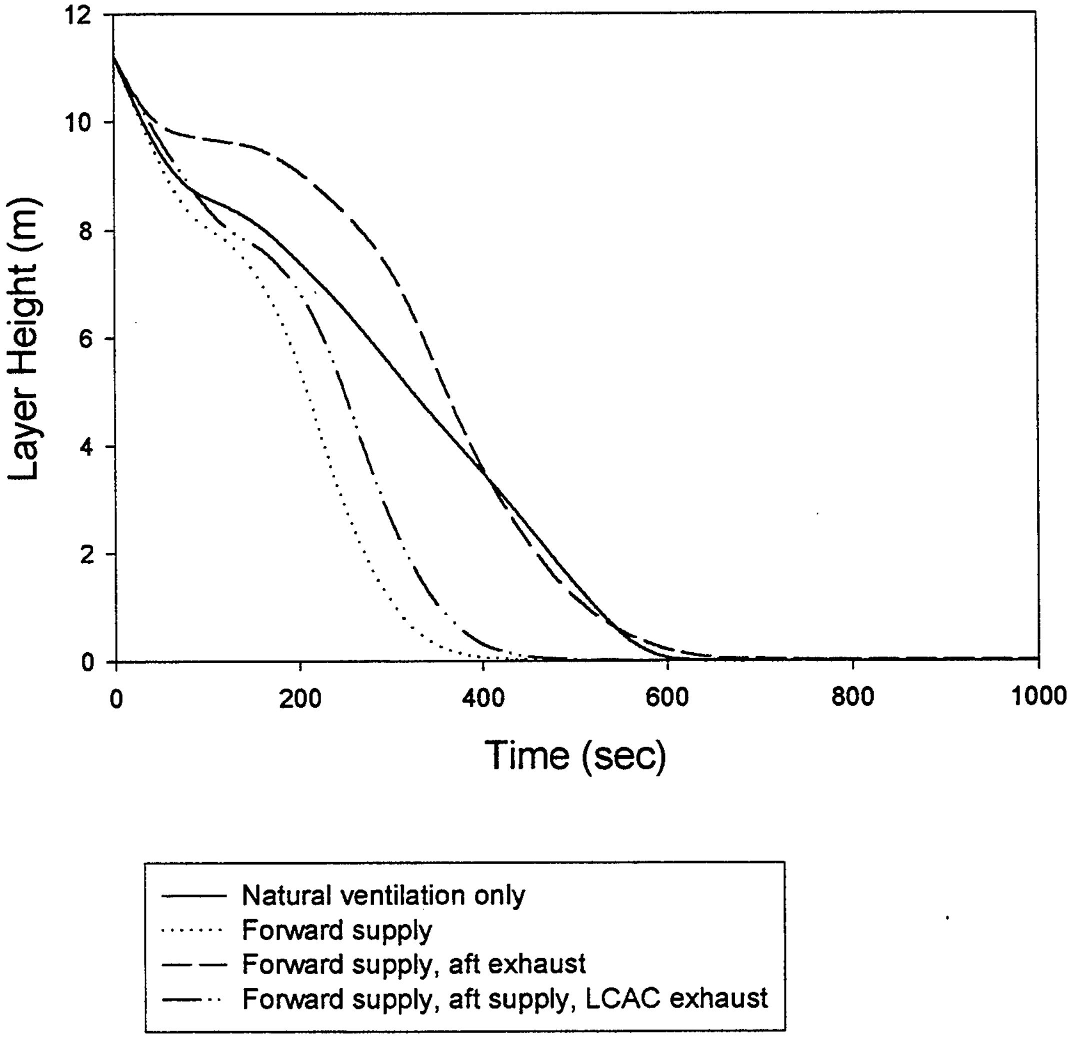


Fig. 24 – The effect of varying mechanical ventilation conditions on the smoke layer interface height in the WD for a fire in the WD with the stern gate closed

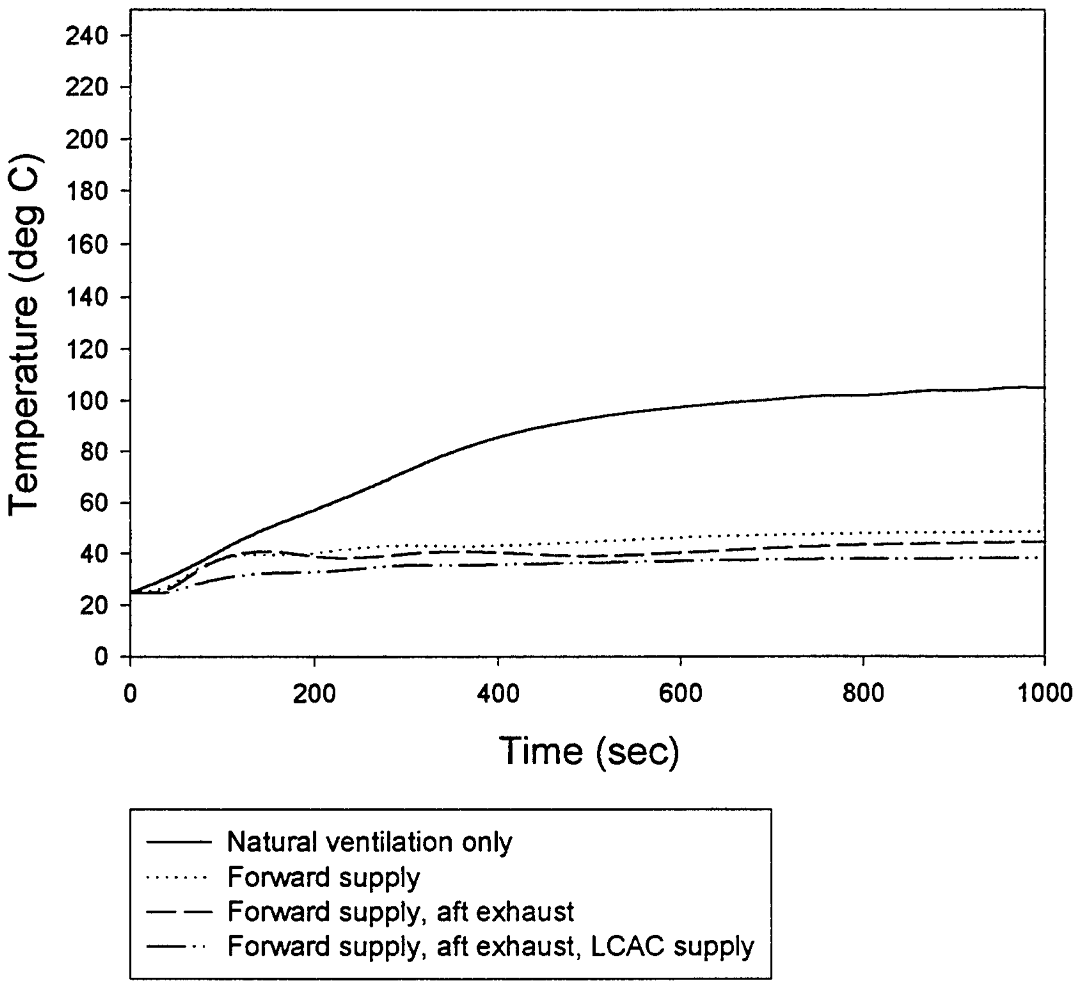


Fig. 25 – The effect of varying mechanical ventilation conditions on the upper layer gas temperatures in the MVSA/UVSA for a fire in the WD and the stern gate closed

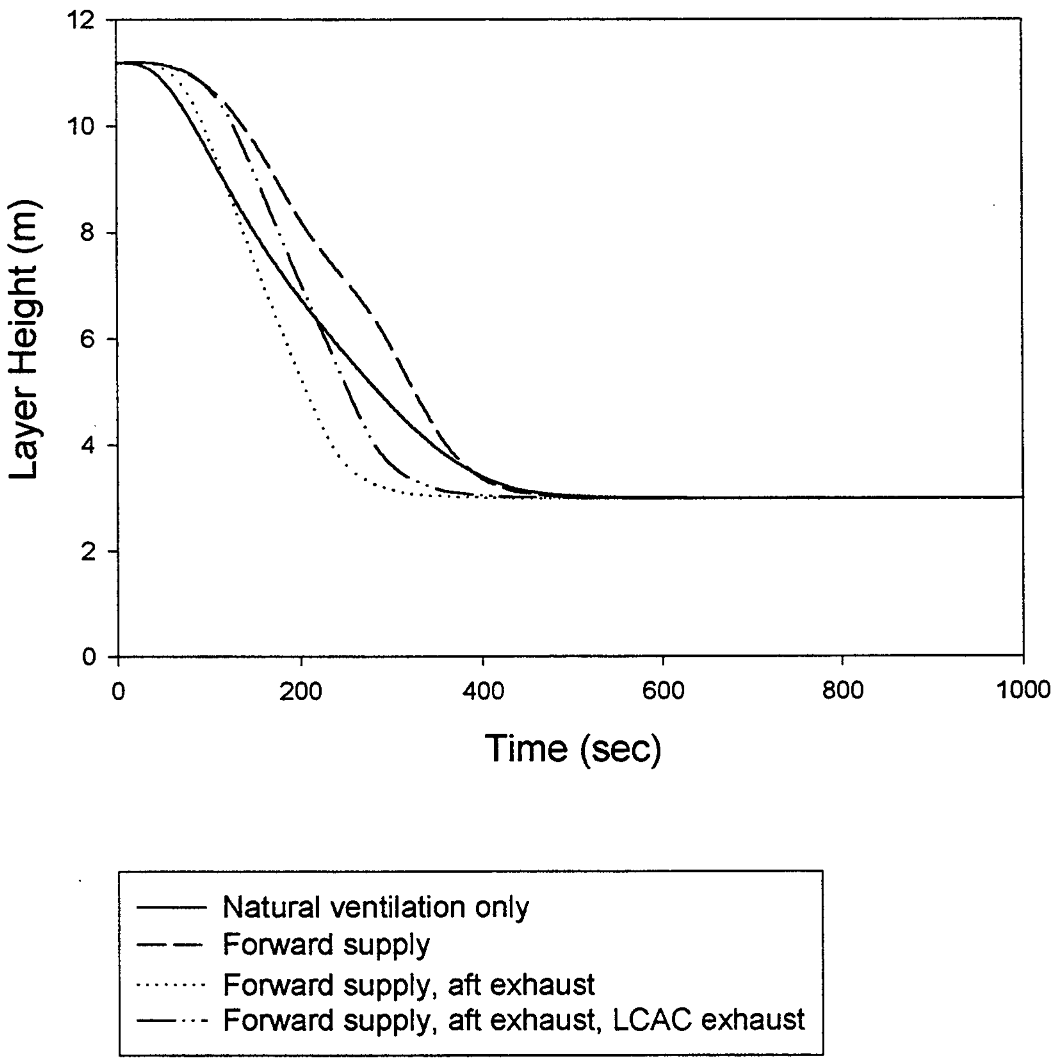


Fig. 26 – The effect of varying mechanical ventilation conditions on the smoke layer interface height in the MVSA/UVSA for a fire in the WD with the stern gate closed

and MVSA/UVSA areas under several ventilation configurations. The following configurations were included in the evaluation:

- No mechanical ventilation with only natural ventilation associated with a 14 m^2 opening to weather (approximates weapons effects);
- Forward supply at MVSA and UVSA levels and natural venting through opening to weather;
- Forward supply at MVSA and UVSA levels, aft WD exhaust, and natural venting through opening to weather; and
- Forward supply at MVSA and UVSA levels, aft WD fans in supply mode, LCAC fans in exhaust mode, and natural venting through opening to weather.

The temperature results for the hot layer in the WD depicted in Figure 23 and for the MVSA/UVSA in Figure 25 demonstrate that, using the forward supply at the MVSA/UVSA levels and aft WD exhaust, tenable conditions are maintained with the stern gate closed. This impact is due to the large natural vent to weather which allows the extra supply air to vent to weather. In the absence of such a large vent area a balance between the quantity of supply air and exhaust air should be maintained. The results in these figures show that for the highest reduction levels in upper layer gas temperatures were achieved with the following configuration:

- Forward supply fans at MVSA and UVSA levels on;
- Aft WD fans operating in supply mode (reversed from normal mode); and
- LCAC fans operating in exhaust mode (reversed from normal mode).

This configuration is the recommended ventilation strategy when the stern gate remains closed.

If the stern gate cannot be opened, it is important to maintain an airflow balance in the space. If one or more of the recommended supply fans are not available, the LCAC exhaust rate should be reduced accordingly. If the LCAC fans are not available, the aft WD fans should be operated in the exhaust mode and the forward MVSA and UVSA fans in supply mode, similar to the doctrine described for the stern gate open scenario. The situation-dependent factor of greatest importance to the ventilation strategy is the size of the vent to weather created by weapons effects. Depending upon the opening size, opening location relative to the fire, and opening elevation, modifications to the recommended doctrine may be warranted. These modifications would be based on the judgement of the On Scene leader, Repair Party Leader, and DCA.

Reversing the fans may cause problems that were not considered in the modeling effort. Issues such as time to modify the fan alignment and potential failures due to the modifications were not included in the analysis. The ventilation recommendations for the stern gate closed scenario should be evaluated in terms of implementation feasibility. Consideration should be given to providing a semi-automatic means to implement the appropriate ventilation configuration. If reversing the aft WD fans or LCAC fans is not feasible, the maximum quantity of ventilation should be provided for the given vent area to the weather. This goal is to strike the best air balance compromise.

Recommendations

Given the scenario where the stern gate remains closed, the ventilation components should be configured as follows;

- Forward supply fans at MVSA and UVSA levels on;
- Aft WD fans operated in the supply mode (reversed from normal mode); and
- LCAC fans operated in the exhaust mode (reversed from normal mode).

If the LCAC fans are unavailable and the vent area created by weapons effects is large enough, the forward supply fans (MVSA/VUSA) should be run in addition to the aft WD fans in exhaust mode (normal). Depending upon the size and location of the vent area relative to the fire location, adjustments to this doctrine may be warranted.

6.0 FIRE FIGHTING AND HEAT/SMOKE MANAGEMENT DOCTRINE

The purpose of this effort was to develop the most effective fire fighting doctrine for a large fire, most likely involving Class B fuels, in the WD or VSAs. Specifically, the recommended doctrine was applied to each of the three postulated weapons hit scenarios addressed in the TSS/BDRA involving large fires in the WD and/or VSAs. Once approved, the doctrine will become part of the ship specific LPD17 emergency procedures.

In order to effectively control a fire in the WD or VSAs, two primary aspects must be addressed: (1) heat and smoke management; and (2) fire fighter access. Heat and smoke management is necessary to maintain both tenable conditions that will not threaten the primary or secondary mission of the ship and to allow fire fighter access to the space. In many cases, the AFFF sprinkler systems will help maintain tenable conditions and control a fire. However, for several of the scenarios postulated in this analysis, the AFFF sprinkler systems are not available. Providing fire fighter access to the VSAs and WD is critical to controlling the fire via manual suppression efforts.

In practice, the doctrine will provide the most effective use of available systems to protect the ship and maintain access to combat a fire in the WD and/or VSAs. Section 6.2 summarizes the general doctrine for heat and smoke management. Technical justification, based on extensive computer fire modeling, of the recommended doctrine is presented in Section 5.0. Section 4.4 addresses fire fighter access to the spaces, based on available access paths and fire fighting equipment. Application of the recommended doctrine is illustrated for Hit Scenarios 2, 6, and 8A, as described in the TSS/BDRA [1], in Sections 6.2.1, 6.2.2 and 6.2.3 respectively.

The goal of the heat and smoke management is to maintain tenable conditions in the WD and VSAs to protect the vehicles and cargo and to permit crew access to the spaces for manual fire fighting efforts. As discussed in Section 5.2 of this report, limiting the hot gas temperatures in the affected spaces to less than 150 °C (300 °F) maintains fire fighter access and limits equipment damage. If this goal can be accomplished, damage to the vehicles and cargo will be limited, and fire fighters will be able to access the space. In limited cases, depending on the fire size and location, it may not be possible to achieve this goal in all areas of the WD and VSA. However, the recommended doctrine will both help mitigate the impact of a fire as well as provide the overall best approach for controlling heat and smoke.

The recommended doctrine provides a rational approach to heat and smoke management in the WD and VSAs in the event of a large fire. The doctrine includes several possible contingencies, with appropriate actions. However, fires, especially large ones, are complex and unique events. Coupled with a weapons hit, scenarios may develop which are not addressed by this doctrine. The specific conditions of a fire and the effectiveness of the recommended doctrine on maintaining tenability in the WD and VSA spaces must be monitored carefully during a fire. If either the heat and smoke management guidelines or the fire fighting doctrine is not being effective, the scene leader should modify the fire fighting efforts as appropriate. If no actions can control the fire, appropriate containment actions should be taken to save the ship.

6.1 General Heat and Smoke Management Doctrine

The general doctrine utilizes all available MEFP systems, as appropriate. The doctrine also provides recommendations to address contingencies, such as the loss of one or more systems.

A goal of the recommended doctrine was to provide a simple but effective approach to manage the heat and smoke from a fire. Therefore, with one exception, the doctrine is not affected by loss of MEFP systems. If one or more systems are not available, the doctrine can be followed to the next step. The one exception is for the stern gate. Opening the stern gate is critical to managing the buildup of heat and smoke. If the stern gate is not operational, an alternative doctrine approach is recommended.

The recommended heat and smoke management doctrine has been graphically portrayed in a flow chart format similar to that found in NSTM 555. The doctrine in these four figures covers the potential fire development in the WD, MVSA, UVSA, and LVSAs. The description of this doctrine has been divided into five cases. Case I and Case II address fires in open spaces and closed spaces, respectively. Case III covers the contingencies associated with the failure to open the stern gate. Case IV provides guidance for AFFF system contingencies and Case V covers fan availability contingencies. In general, the ordering of the actions indicates relative priority; however, concurrent actions are expected.

6.1.1 Case I. Open Space (WD, MVSA, UVSA) Doctrine (Figures 27 and 28)

(1) Utilize the overhead AFFF sprinklers, to the extent possible, to control the fire – if damaged, refer to *Doctrine Case IV – AFFF System Contingencies*;

(2) Maneuver the ship to prevent smoke ingestion from weather and help exhaust smoke from the WD by having the stern gate open to the downwind direction;

(3) Open the upper stern gate – if the stern gate is not operational, proceed to *Doctrine Case III – Stern Gate Contingencies*;

(4) Activate or continue to operate the MVSA and UVSA ventilation supply fans, located in the forward bulkhead. If not available, proceed to Doctrine Case V – Fan Availability Contingencies;

(5) Activate or continue to operate the WD ventilation exhaust fans, located in the stern;

(6) Activate or continue to operate the LCAC ventilation supply fans, located in the port and starboard wingwalls of the WD; and

(7) Access the fire areas and complete fire extinguishment.

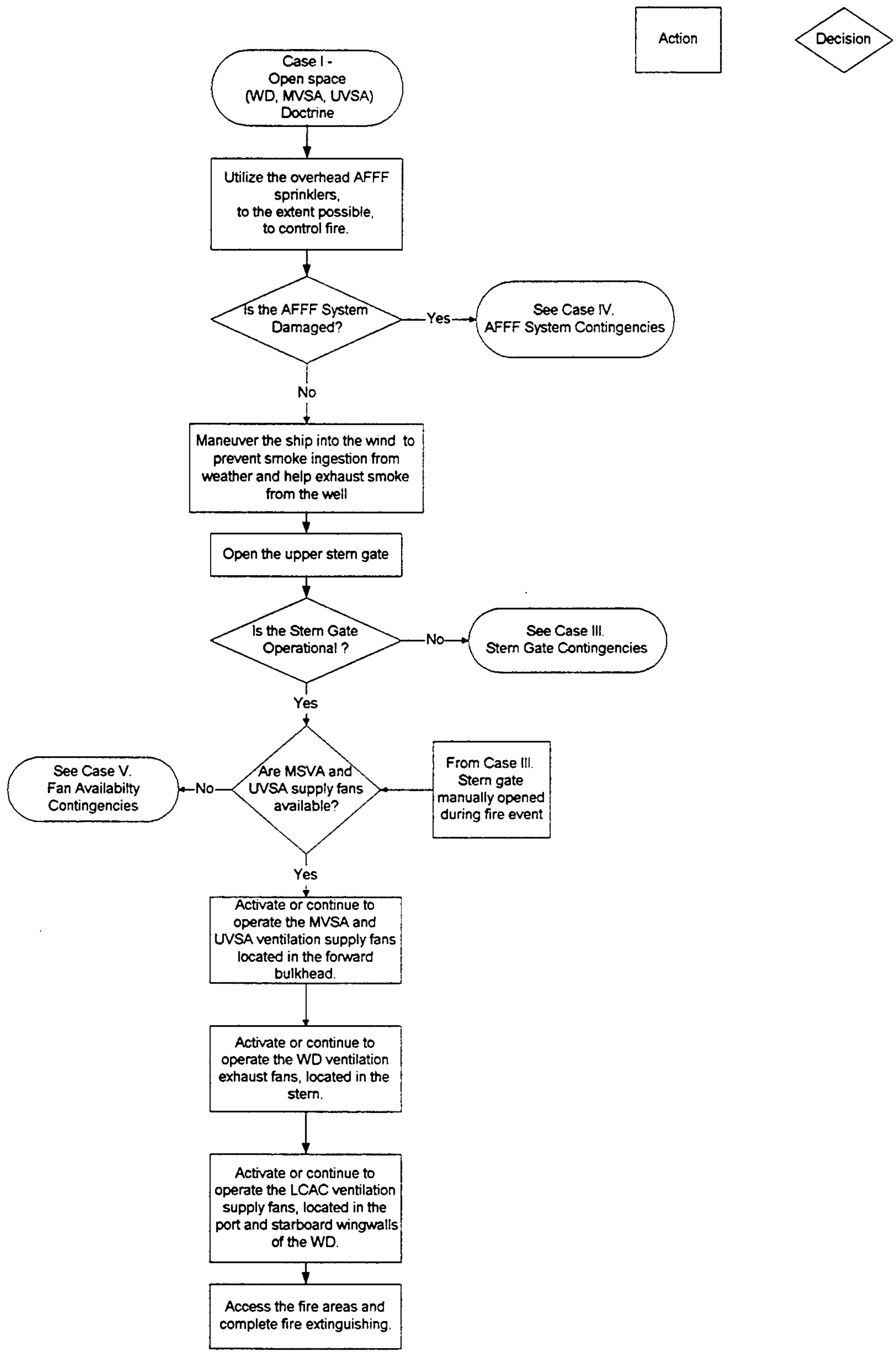
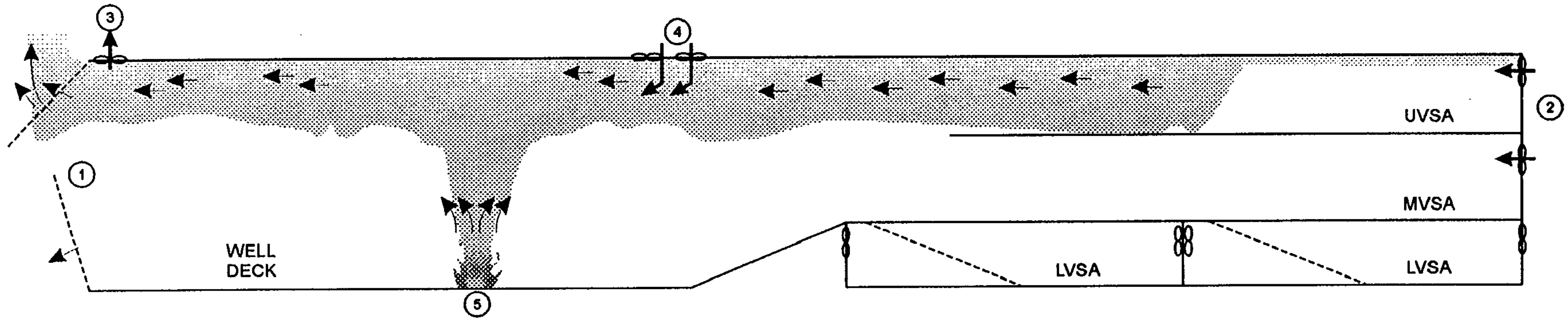


Fig. 27 – Open space doctrine for a large fire in the WD, MVSA, or UVSA



① OPEN STERN GATE
② MVSA/UVSA – VENTILATION SUPPLY
③ WELL – VENTILATION EXHAUST
④ LCAC – VENTILATION SUPPLY
⑤ ATTACK FIRE

Fig. 28 – Open space ventilation configuration, stern gate open

Note: with the exception of the stern gate operation, if a system is not available proceed to the next recommended action item.

6.1.2 Case II. Closed Space (LVSAs) Doctrine (Figure 29)

(1) Utilize the overhead AFFF sprinklers, to the extent possible, to control the fire – if damaged, refer to *Doctrine Case IV – AFFF System Contingencies*;

(2) Isolate the LVSA space (ventilation, mechanical, electrical) and conduct an indirect fire attack in accordance with NSTM 555;

(3) Maneuver the ship into the wind to prevent smoke ingestion from weather and help exhaust smoke from the Well;

(4) Ventilate the WD, MVSA, UVSA as directed in Case I – Open Space Doctrine; and

(5) Set negative ventilation in the LVSA compartment and complete the fire attack.

6.1.3 Case III. Stern Gate Contingencies (Figure 30 and 31)

(1) If conditions permit, use the manual chainhoist system or hydraulic hand pumps to open the upper stern gate;

(2) Activate or continue to operate the MVSA and UVSA ventilation supply fans, located in the forward bulkhead – if forward supply fans are not operational, refer to *Doctrine Case V – Fan Availability Contingencies*;

(3) If available, reverse the LCAC ventilation supply fans located in the port and starboard wingwalls of the WD to the exhaust mode;

(4) Provided that the LCAC fans are operating in an exhaust mode, reverse the WD ventilation exhaust fans located in the stern to the supply mode – if the LCAC fans are not available or have been turned off, maintain the WD ventilation fans in the exhaust mode;

(5) If the stern gate is opened once the WD and LCAC ventilation fans have been reversed, do not alter ventilation configuration. If the stern gate is opened prior to the fans being reversed, refer to *Doctrine Case I* – Open Space Doctrine for ventilation configuration recommendations; and

(6) Access the fire areas and complete fire extinguishing.

Note: if a system is not available proceed to the next recommended action item unless noted otherwise.

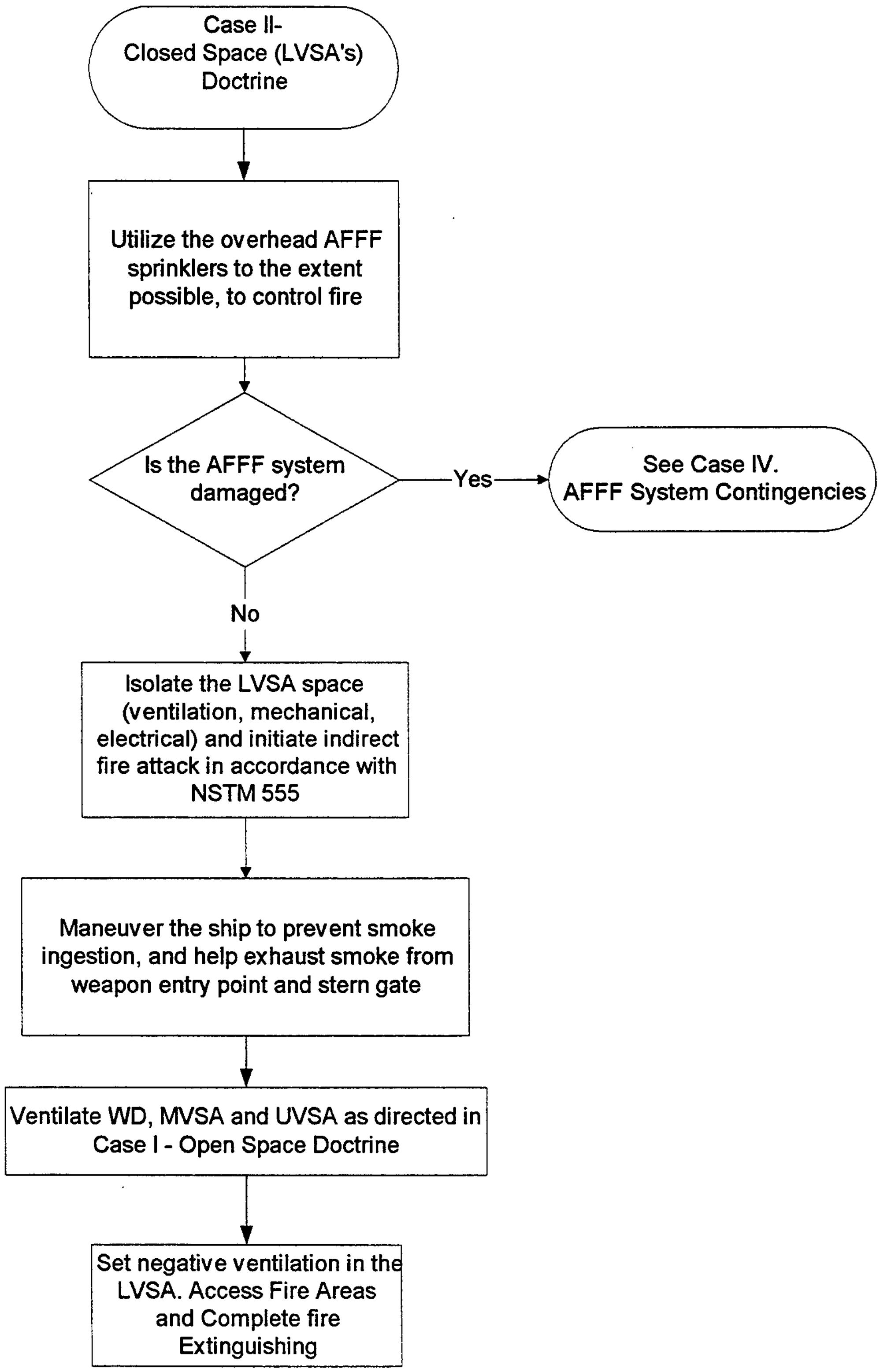


Fig. 29 – Closed Space (LVSAs) Doctrine

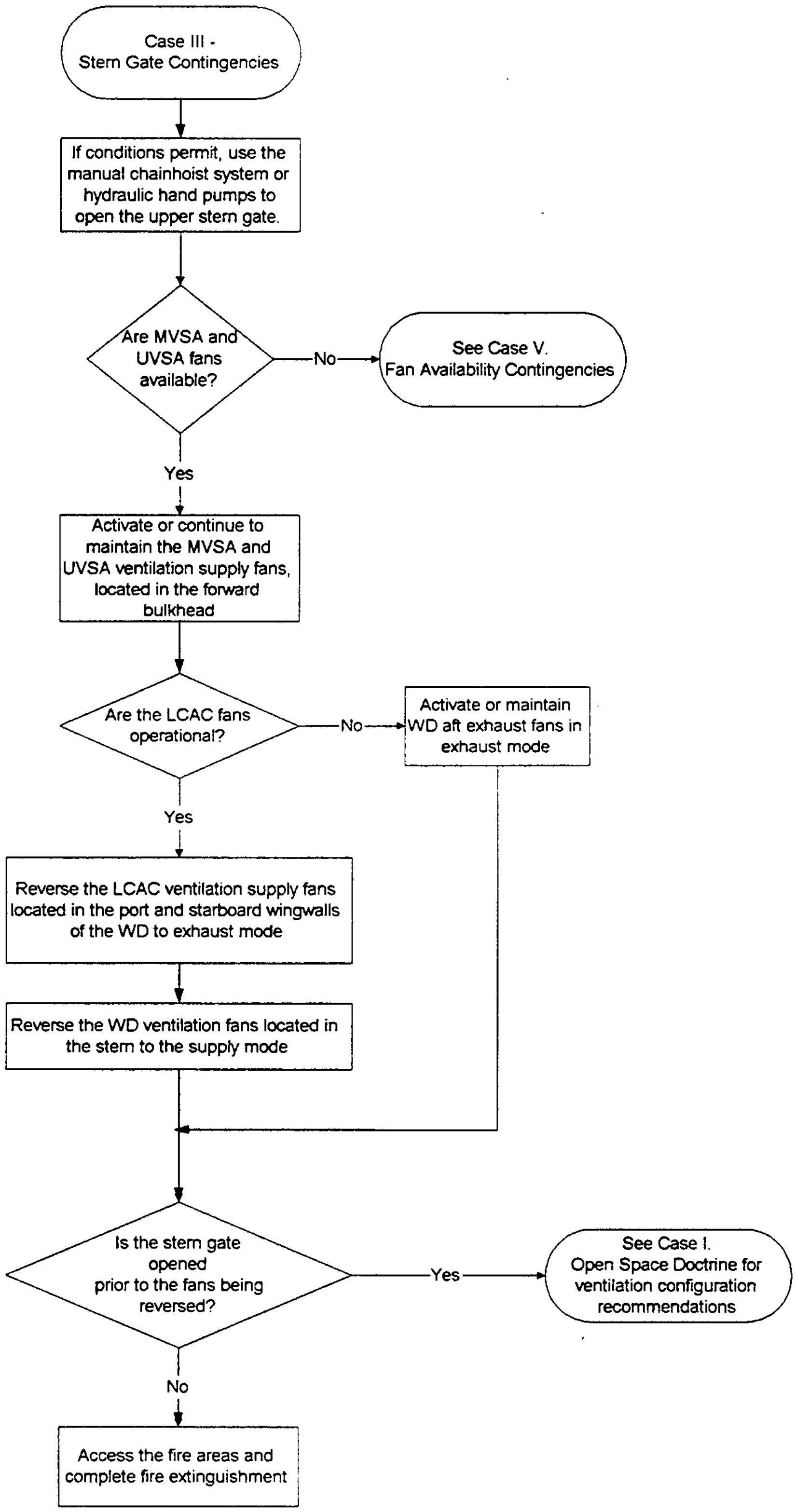


Fig. 30 – Stern gate contingencies doctrine for a large fire in the WD, MVSA, or UVSA

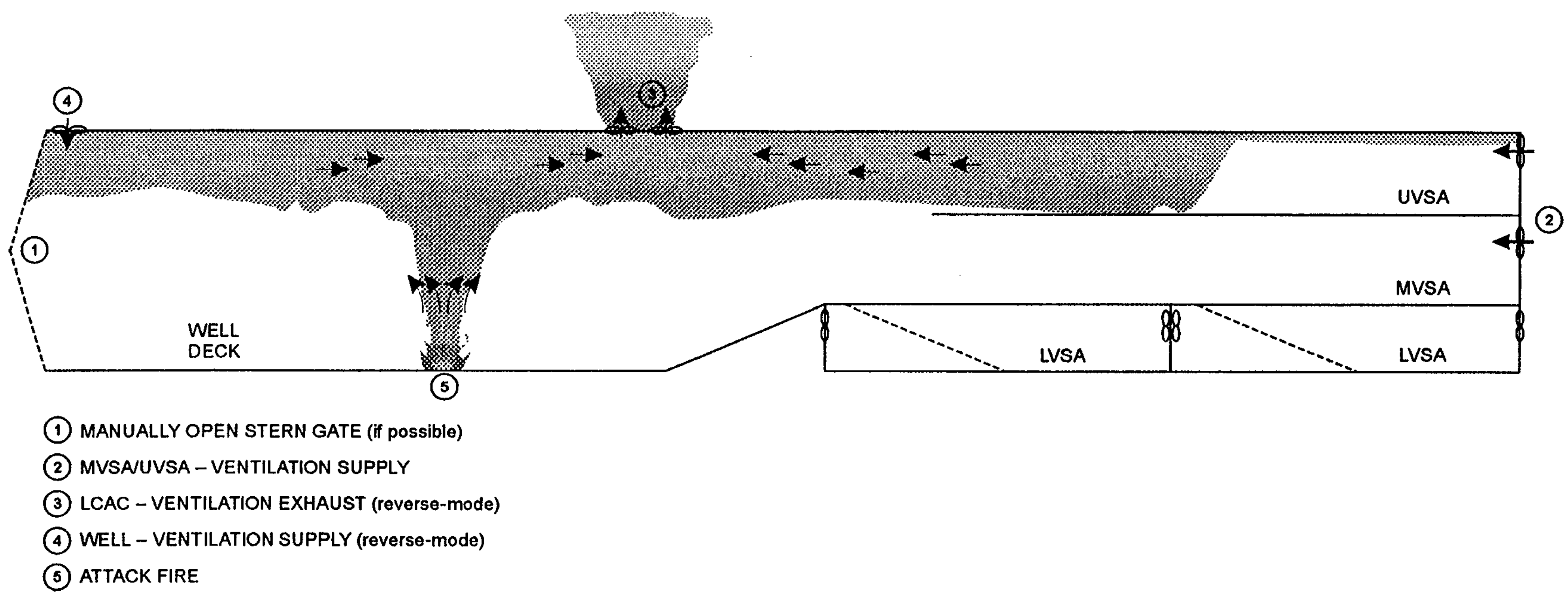


Fig. 31 – Open space ventilation configuration, stern gate closed

6.1.4 Case IV. AFFF System Contingencies (Figure 32)

(1) If the overhead AFFF sprinkler system is damaged:

(a) If AFFF/water is available to the overhead piping, attempt to flow AFFF/water in the vicinity of the fire;

(b) If no AFFF/water is available, send repair party to investigate the firemain and proportioning stations to assess the extent of AFFF sprinkler damage; and

(c) If resources are available, repair the AFFF sprinkler system.

6.1.5 Case V Fan Availability Contingencies (Figure 33)

(1) If there is a fan availability issue and the stern gate is open:

(a) operate the available fans in normal mode; and

(b) access the fire areas and complete fire extinguishment.

(2) If there is a fan availability issue and the stern gate is closed:

(a) If the WD exhaust fans are available, they should be operated regardless of other fan availability. The WD exhaust should be complimented by the MVSA/UVSA supply fans if they are available. If the MVSA/UVSA supply fans are not available, the LCAC fans could be used to balance the WD exhaust fans by the use of partial power to the LCAC fans;

(b) If the WD exhaust fans are not available, the other fans should not be operated unless the LCAC fans can be reversed and balanced with the MVSA/UVSA supply fans; and

(c) Continue manual efforts to open stern gate as resources allow.

(3) Access the WD or VSAs and complete fire extinguishment.

6.2 Specific Hit Recommendations

This section integrates smoke/heat management recommendations with scenario specific fire fighting recommendations for each of the hits previously analyzed in the TSS/BDRA. These case specific examples illustrate how the general doctrine recommendations developed in Section 6.1 are applied to weapons hit scenarios. For each hit, the section of general doctrine is reproduced in italics and then a description of its application to the hit follows. The narrative presents insight into the integration of the heat/smoke management activities with the access and fire fighting response.

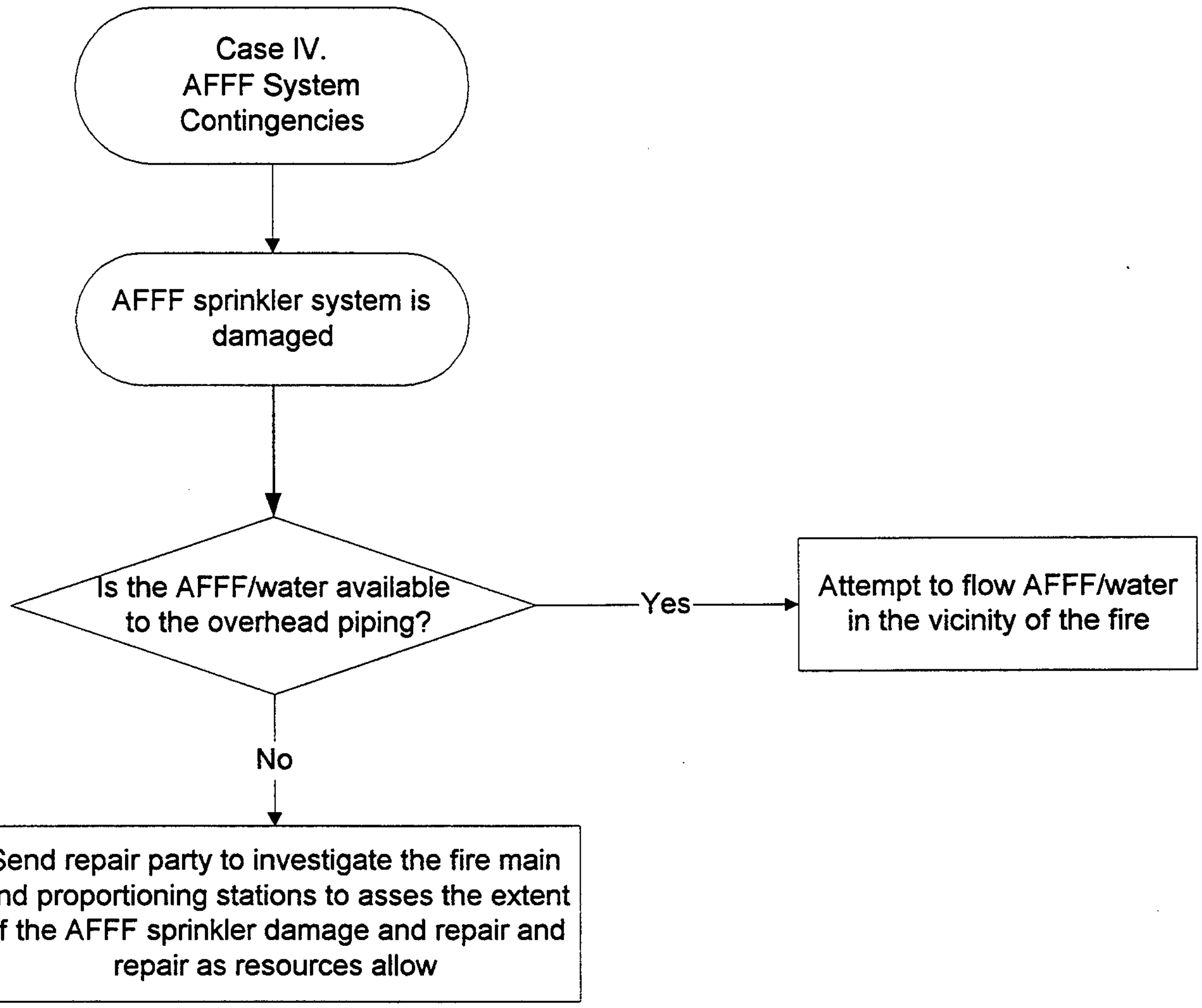


Fig. 32 – AFFF system contingencies doctrine for a large fire in the WD, MVSA or UVSA

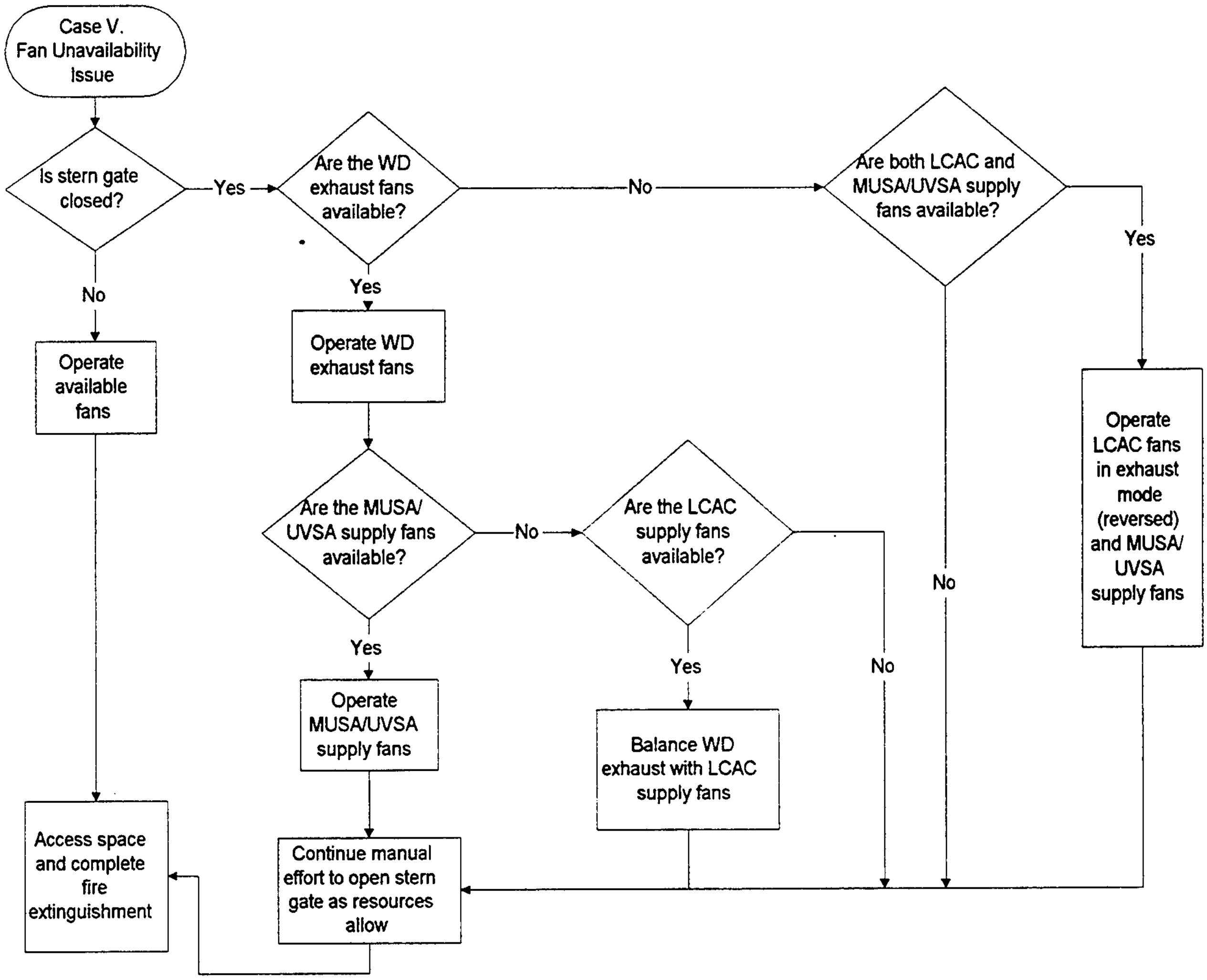


Fig. 33 – Fan availability contingencies for a large fire in the WD, MVSA, or UVSA

6.2.1 Hit 2 – Recommended Doctrine.

Hit 2 results in a large Class B fire in the LVSA (forward) space. Based on the assumptions in the VAR, damage to the LVSA (forward) overhead AFFF sprinklers occurs; however, all other vital MEFP systems are available. Based on the fire location and availability of MEFP systems, *Doctrine Case II – Closed Space (LVSA) Doctrine* is used, as follows[1]:

(1) Utilize the overhead AFFF sprinklers, to the extent possible, to control the fire – if damaged, refer to Doctrine Case IV – AFFF System Contingencies;

The overhead AFFF sprinklers serving the LVSA (forward) are damaged and for the purposes of the TSS/BDRA effort were assumed to be unavailable. If the damage was limited to the distribution piping in the LVSA overhead, there may be benefit in flowing water/AFFF into the space via the damaged pipes. If the risers servicing this space are damaged, it may not be feasible to flow water/AFFF into the LVSA space. This is covered by the doctrine in Case IV.

The AFFF sprinkler systems serving other areas, including the Well, MVSA and UVSA are available. The primary threat from this fire is the potential for fire spread to adjacent areas. In order to prevent vertical fire spread to the MVSA, the sprinklers in the MVSA should be used to pre-wet the deck. Pre-wetting the MVSA deck will cool the deck, help prevent ignition of vehicles and/ or cargo in this area. Pre-wetting should be accomplished with water only (i.e., AFFF injection stations off-line). The addition of the AFFF concentrate will only serve to create slip hazards in the MVSA space. Horizontal fire spread from the LVSA will be limited due to the defined fire zone boundaries. The fire zone boundaries, which separate areas aft and forward of the LVSA (forward), and the wing walls of the space are designed to have fire insulation. Because damage to the insulation may result due to the weapon hit, horizontal fire spread may occur and should be monitored.

The extent to which the overhead AFFF sprinkler systems should be used must be determined by the On Scene leader based on the specific conditions noted. Factors such as water damage, visibility/personnel movement, and the potential for injury due to steam generation should be considered.

[1] It is understood that some actions not directly affecting the fire space can and should be done concurrently, manpower permitting.

Case IV (1a) If the overhead AFFF sprinkler system is damaged:

(i) if AFFF/water is available to the overhead piping, attempt to flow AFFF/water in the vicinity of the fire;

(ii) if no AFFF/water is available, send repair party to investigate the firemain and proportioning stations to assess the extent of damage;

(iii) if resources are available, repair the AFFF sprinkler system.

As a result of the weapon hit, the AFFF sprinkler system piping network is damaged in the LVSA (forward). The extent of damage to the system is not defined in the TSS/BDRA; however, it is likely that the sprinkler piping would be broken in several places and flow to the sprinkler heads would not be possible. If AFFF is available, flowing it to the space would help even if it does not reach the sprinkler heads. If the AFFF proportioning stations are unavailable, plain water should not be applied.

(2) Isolate the LVSA (forward) space (ventilation, mechanical, electrical) and conduct an indirect fire attack.

The LPD-17 Repair 3S investigators should enter the MVSA via the Second Deck P&S platform ladderway (starboard side) at Frame 147 and verify the fire location. Once determined, the On Scene Leader should isolate the LVSA (forward) space (mechanical & electrical) and orchestrate an indirect attack using a Portable Exothermic Cutting Unit (PECU) and a 3.8 cm (1½-in) hoseline fitted with a vari-nozzle or a navy all-purpose nozzle fitted with a 1.2 m (4-ft) wide-angle fog applicator. To be most effective, the access cut for the indirect cooling application should be made at some distance away from the damage vent opening (i.e., starboard side of the MVSA deck). Ventilation to the fire space should be secured to maximize the effectiveness of the indirect attack. The water application should be directed to the upper portions of the interior atmosphere to optimize steam generation. The observation of the changes in the effluent exhausting from the PECU-created nozzle opening can be used to monitor the effectiveness of the indirect attack. The mixture of smoke and condensing steam exhausting from the vent opening should change to condensing steam with very little smoke when the fire is suppressed. At this point the indirect attack is complete and preparations to enter the LVSA (forward) space should commence.

(3) Maneuver the ship into the wind to prevent smoke ingestion from weather and help exhaust smoke from the WD by having the stern gate open to the downwind direction.

(4) Ventilate the WDeck, MVSA and UVSA as directed in Doctrine Case I – Open Space Doctrine.

Power is available and the stern gate is postulated to be operational for this hit scenario. Therefore, the upper stern gate should be opened once the LVSA has been isolated. Fire spread into the MVSA or WD is not anticipated for this scenario due to the pre-wetting of the exposed decking. However, limited pyrolysis of fuels and steam from the sprinklers and/ or handlines can reduce visibility and raise the temperature of these spaces. Therefore, opening the stern gate allows heat and steam to vent out the stern of the ship. Maneuvering the ship into the wind will also aid in venting smoke and heated gases from the affected areas.

(5) Set negative ventilation in the LVSA (forward) and complete the fire attack.

The LVSA ventilation fans should be used, if available, to help reduce the humidity and cool the space during the fire party entry into the LVSA (forward) space. The attack team should enter from the Second deck LVSA (forward) Escape Trunk (Frame 59.5) with a 3.8 cm (1½-in) handline (or AFFF hose reels, if available) to initiate a direct attack on any remaining fires and complete final extinguishing.

6.2.2 Hit 6 – Recommended Doctrine.

Hit 6 results in a large Class B fire in the WD and MVSA. All vital MEFP systems are available, based on the assumptions of the TSS/BDRA. Based on the fire location and availability of MEFP systems, *Doctrine Case I – Open Space Doctrine* is used, as follows[2]:

(1) Utilize the overhead AFFF sprinklers, to the extent possible to control the fire – if damaged, refer to Doctrine Case IV – AFFF System Contingencies.

The AFFF sprinkler systems are postulated to be available for this hit scenario. These systems can be controlled/monitored from Conflagration Stations No. 3 & 5 and activated in the areas where the fires are located. Pre-wetting areas adjacent to the fires, including vehicles and cargo, is recommended to prevent radiant heat damage and fire spread. The AFFF sprinkler systems will likely be capable of controlling the large Class B fire.

(2) Maneuver the ship to prevent smoke ingestion from weather and help exhaust smoke from the WD by having the stern gate open to the downwind direction.

[2] It is understood that some actions can and should be done concurrently, manpower permitting.

(3) *Open the upper stern gate – if the stern gate is not operational, proceed to Doctrine Case III – Stern Gate Contingencies.*

Power is available and the stern gate is postulated to be operational for this hit scenario. The upper stern gate should be opened as soon as possible. Because the AFFF sprinkler systems are also operational, time will likely be available to open the lower stern gate. Opening the stern gate will allow heat and smoke to vent out of the stern of the ship and will help maintain tenable conditions to enhance fire party access.

(4) *Activate or continue to operate the MVSA and UVSA ventilation supply fans, located in the forward bulkhead (Frame 62.5).*

(5) *Activate or continue to operate the WD ventilation exhaust fans, located in the stern.*

(6) *Activate or continue to operate the LCAC ventilation supply fans located in the port and starboard wing walls of the WD; and*

All ventilation systems are postulated to be available for this hit scenario. With the stern gate open, the forward MVSA and UVSA supply fans, LCAC supply fans, and aft WD exhaust fans will help to vent heat and smoke from the WD and VSAs. In addition, the supply ventilation will help dilute and cool the hot gases emanating from the fire. Because large quantities of steam will be generated from the AFFF sprinklers, venting and cooling the spaces will also help maintain tenable conditions to enable fire party access.

(7) *Access the fire areas and complete fire extinguishment.*

The visibility in the fire area will be reduced due to the cooling effect and draft created by the sprinkler spray pattern, which tends to push the smoke and gases down toward the lower levels of the fire space. The performance of thermal imaging cameras will also be degraded if they are in use. It is important to start active de-smoking as soon as the main fire is suppressed[3]. Prior to attack team entry, consideration should be given to securing AFFF to any flowing sprinkler zones adjacent to the AFFF zone where the major fire source is located. This action may help to improve visibility and lessen the slip hazard with foam. The attack/investigation team(s) should enter from the Repair Three areas and proceed to the MVSA with an 3.8 cm (1½-inch) AFFF handline (or use the AFFF hose reels if available) via the Second Deck P&S platform ladderways (Frame 147).

[3] The desmoking process will be more difficult due to the movement of relatively cooler smoke.

Dispatching two teams will help to expedite the investigation process and enable an earlier shut-down of the sprinkler systems. One team should be dispatched from the starboard ladderway to check the MVSA and the other team should be dispatched from the port ladderway. The port ladderway team should proceed directly to the WD to extinguish any remaining satellite fires. The AFFF sprinkler system zone flowing over the major fire source should not be secured until all fires have been verified to be under control. Additional support teams will most likely be required to help remove damage debris and complete fire overhaul.

6.2.3 Hit 8A – Recommended Doctrine

Hit 8A results in a large Class B fire in the MVSA. Based on the assumptions of the TSS/BDRA, electrical power is not available aft of Frame 110 during the first 15-20 minutes. As a result, automated operation of the stern gate is not available during this time frame. The AFFF sprinkler systems serving the WD and VSAs are damaged by the hit and are also not available during the first 15-20 minutes. The aft WD exhaust fans and LCAC fans are not available for this scenario, however supply fans in the MVSA and UVSA are operable. Based on the fire location and availability of MEFP systems, *Doctrine Case I – Open Spaces (WD, MVSA, UVSA) Doctrine and Case III– Stern Gate Contingencies* are used, as follows[4]:

(1) Utilize the overhead AFFF sprinklers, to the extent possible, to control the fire – if damaged, refer to Doctrine Case IV – AFFF System Contingencies.

(1a) If the overhead AFFF sprinkler system is damaged:

(i) if AFFF/water is available to the overhead piping, attempt to flow AFFF/water in the vicinity of the fire.

(ii) if no AFFF/water is available, send repair party to investigate the firemain and proportioning stations to access the extent of AFFF sprinkler damage.

(iii) if resources are available, repair the AFFF sprinkler system.

Based on the VAR, the overhead AFFF sprinkler systems are not available during the first 15-20 minutes of the hit scenario. During this time, the firemains and proportioning stations are repaired. However, even when the systems are back on-line, the sprinkler grid piping is damaged from the hit, which limits the effectiveness of the sprinkler systems.

[4] It is understood that some actions can and should be done concurrently, manpower permitting.

Once the system is back on-line, if deemed appropriate by the On Scene Leader, the damaged piping network may be used to flow AFFF or water into the WD, MVSA, and/ or UVSA. Although the AFFF/water flow may not extinguish or even control the fire, the water will help cool the space and inhibit fire spread.

(2) *Maneuver the ship to prevent smoke ingestion from weather and help exhaust smoke from the WD by having the stern gate open to the downwind direction.*

(3) *If conditions permit, use the manual chainhoist system or hydraulic hand pumps to open the upper stern gate.*

Automated operation of the stern gate is not available during the first 15-20 minutes of this hit scenario. Given the relative importance of venting hot gases and smoke via the stern gate, manual operation of the upper gate should be attempted as soon as possible. It is unlikely that the gate will be fully opened during this time, but having the gate even partially opened will help exhaust the space. Although power is postulated to be restored for this hit scenario, complete manual operation of the gate could be required in an actual emergency. Therefore, attempting to open the upper stern gate manually should not be delayed.

(4) *Activate or continue to operate the MVSA and UVSA ventilation supply fans, located in the forward bulkhead – if forward supply fans are not operational, refer to Doctrine Case V – Fan Availability Contingencies.*

The MVSA and UVSA supply fans are postulated to be operable for this hit scenario. The supply fans will help to cool the atmosphere and push smoke toward the stern and/ or damage vent opening[5].

(5) *If available, reverse the LCAC ventilation supply fans located in the port and starboard wing walls of the WD to the exhaust mode.*

The LCAC fans are not available for this hit scenario.

(6) *Provided that the LCAC fans are operating in the exhaust mode, reverse the WD ventilation exhaust fans located in the stern to the supply mode – if the LCAC fans are not available or have been turned off, maintain the WD ventilation fans in the exhaust mode.*

[5] The attack team(s) may opt to secure the MVSA supply fans during the indirect foam application into the MVSA.

Because the LCAC fans are not available, the WD ventilation fans should be used in the exhaust mode. However, the WD exhaust fans are not available for this hit scenario. No alternative action is required due to the loss of the exhaust fans.

(7) *If the stern gate is opened once the WD and LCAC ventilation fans have been reversed, do not alter the ventilation configuration. If the stern gate is opened prior to the fans being reversed the, refer to Doctrine Case I – Open Space Doctrine for ventilation configuration recommendations.*

Because only the forward MVSA and UVSA supply fans are operable, no ventilation configuration changes are necessary once the stern gate is opened. The forward supply with open stern gates will help cool the space and exhaust smoke to enhance fire party access to the fire spaces.

(8) *Access the fire areas and complete fire extinguishing.*

It is unlikely that access from the Repair Three areas via the Second Deck P&S platform ladderways will be possible due to the close proximity of the fire. The Repair Two attack teams should initiate the attack from the Second Deck air lock located at Frame 62.5 in the Troop Living Space. Assuming the Repair Three investigators are able to verify that the MVSA is the main fire location, the Repair Two On Scene Leader should set the vertical boundary in the UVSA and assess the practicability of conducting a direct attack on the MVSA fire. If heat does not deny access, the attack team should enter the MVSA from the fixed ramp at Frame 105 with an 3.8 cm (1½-in) AFFF handline fitted with a 361 liters per minute (95 GPM) vari-nozzle (or use AFFF hose reels, if available) and conduct a direct attack on the fire[6]. If heat does deny access, the On Scene Leader will have to first proceed with an indirect attack. This attack should be initiated from the UVSA aft overhang at Frame 120[7]. The goal is to apply as much AFFF as possible in the vicinity of the fire and knock down a major portion of the burning surface area. This action should significantly reduced the heat release rate of the fire and improve conditions to enable a direct fire attack. The indirect application of foam should continue until direct entry into the MSVA is possible. Once conditions permit, a direct attack from the UVSA fixed ramp and/ or the Second Deck P&S platform ladderways (Frame 140) should be commenced to complete final extinguishing. The On Scene Leader(s) and

[6] An attack line cannot exceed six hose lengths (91 m or 300 ft) if using an AFFF eductor and AFFF 19 liters (5 gallon) cans.

[7] A trade-off will have to be made between the exact indirect AFFF application point and the thermal challenge presented.

Attack Team Leaders should anticipate the need for rotational relief of hose teams and plan accordingly. Additional support teams may be necessary to help remove damage debris and complete fire overhaul.

7.0 CONCLUSIONS AND RECOMMENDATIONS

A general set of guidelines for smoke and heat management have been developed to address the potential for large fires in the LPD-17 WD and VSAs. The analysis clearly demonstrates the advantages of venting the open spaces either with natural or mechanical ventilation. These guidelines rely on providing natural and mechanical ventilation of the WD and VSAs to minimize the buildup of dense smoke and heat. Contingencies have been identified within the guideline framework to address conditions associated with plausible weapons hits. These guidelines have been illustrated for the three hits previously evaluated in the TSS/BDRA work on the contract design for the LPD-17. These guidelines are expected to be adopted as LPD-17 ship specific doctrine.

The recommended strategy provides numerous benefits for combating battle induced fire damage on the LPD-17, including the following:

- Improved accessibility to the WD and VSAs;
- Reduced temperatures which increases the time individual fire fighters can sustain fire fighting activities before requiring relief;
- Improved visibility which allows quicker access to the main fire location; and
- Reduced damage to the vehicles, cargo, and other items that form the nucleus of the primary mission of the ship.

These benefits have been demonstrated through the use of computer fire modeling.

Coupled with the heat and smoke management guidelines are fire fighting doctrine recommendations. Fire fighting operations are a very dynamic entity; however, basic strategies and resource utilization recommendations have been outlined. These recommendations have been made in the specific context of the three hits. The recommendations focus on access approaches and hose team management strategies.

The ventilation configuration recommendations range in level of complexity. Opening the stern gate to provide natural ventilation for WD, MVSA, or UVSA fires is relatively simple. Ventilation configuration for the mechanical ventilation of the WD/MVSA/UVSA with and without the stern gate open become more complicated. The ventilation configuration for the open spaces with the stern gate closed is the most complex in that it requires the activation of fans in reversed mode. The development of automated or semi-automated damage control aides for these reconfigurations should be considered. The feasibility of fan reversals should be independently confirmed.

Because of the challenging nature of any manual fire fighting effort for a major WD fire, it is recommended that doctrine and tactics tests be conducted for this scenario. The objective of these tests would be to assess tactics and procedures in combination with ventilation systems, fixed fire suppression systems, and manual equipment. These tests could be used to verify the ventilation alignments recommended in this report. Also, limitations of an aggressive manual attack (in the absence of an effective installed system) could be identified. Because of the substantial combined Class B and Class A fuel loads, current manual equipment may have limited effectiveness. The use of alternative techniques, such as total flooding using high expansion foam, may be appropriate. The effectiveness of high expansion foam for Class B machinery space fires has been quantified [26]. While there are functional issues to address, the installation of fixed or portable high ex foam system for a potentially overwhelming challenge of a WD fire may be appropriate.

Successful fire fighter access and effective suppression of large battle induced fires will be strongly dependent on having highly trained fire fighters. Battle induced fires will be significantly more difficult than routine fires given blast debris, access obstacles like jammed doors and hatches, and the potential failure of critical support systems (e.g., power, fire main pressure). Training for these scenarios is pivotal to successful battle damage recovery. Optimum heat and smoke management is critical to providing fire fighters a tenable environment in which to work.

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APPENDIX A – MODELING RESULTS

File	Scenario	Top Stem Gate	Bottom Stem Gate	Fire Location	Opening	LCAC	Fans
A	1	closed	closed	Well	.09 m^2	off	no ventilation
D	2	open	closed	Well	none	off	no ventilation
G	3	open	open	Well	none	off	no ventilation
J	4	closed	closed	Well	14 m^2	off	no ventilation
M	5	open	open	Well	14 m^2	off	no ventilation
HHH	6	open	open	Well	14 m^2	supply	no ventilation
III	7	open	closed	Well	14 m^2	supply	no ventilation
Y	8	closed	closed	Well	14 m^2	off	FS, AE
BB	9	open	closed	Well	14 m^2	off	FS, AE
EE	10	open	open	Well	14 m^2	off	FS, AE
WW	11	open	closed	Well	14 m^2	supply	FS, AE
ZZ	12	open	open	Well	14 m^2	supply	FS, AE
CCC	13	closed	closed	Well	14 m^2	off	FS
DDD	14	open	open	Well	14 m^2	off	FS
EEE	15	open	closed	Well	14 m^2	off	FS
FFF	16	open	open	Well	14 m^2	supply	FS
GGG	17	open	closed	Well	14 m^2	supply	FS
OOO	18	closed	closed	Well	14 m^2	exhaust	FS, AS
B	19	closed	closed	MVSA	.09 m^2	off	no ventilation
E	20	open	closed	MVSA	none	off	no ventilation
H	21	open	open	MVSA	none	off	no ventilation
K	22	closed	closed	MVSA	14 m^2	off	no ventilation
N	23	open	open	MVSA	14 m^2	off	no ventilation
MMM	24	open	open	MVSA	14 m^2	supply	no ventilation
NNN	25	open	closed	MVSA	14 m^2	supply	no ventilation
Z	26	closed	closed	MVSA	14 m^2	off	FS, AE
CC	27	open	closed	MVSA	14 m^2	off	FS, AE
FF	28	open	open	MVSA	14 m^2	off	FS, AE
XX	29	open	closed	MVSA	14 m^2	supply	FS, AE
AAA	30	open	open	MVSA	14 m^2	supply	FS, AE
JJJ	31	open	closed	MVSA	14 m^2	off	FS
KKK	32	open	open	MVSA	14 m^2	supply	FS
LLL	33	open	closed	MVSA	14 m^2	supply	FS
PPP	34	closed	closed	MVSA	14 m^2	exhaust	FS, AS
C	35	closed	closed	UVSA	.09 m^2	off	no ventilation
F	36	open	closed	UVSA	none	off	no ventilation
L	37	closed	closed	UVSA	14 m^2	off	no ventilation
AA	38	closed	closed	UVSA	14 m^2	off	FS, AE
DD	39	open	closed	UVSA	14 m^2	off	FS, AE
YY	40	open	closed	UVSA	14 m^2	supply	FS, AE

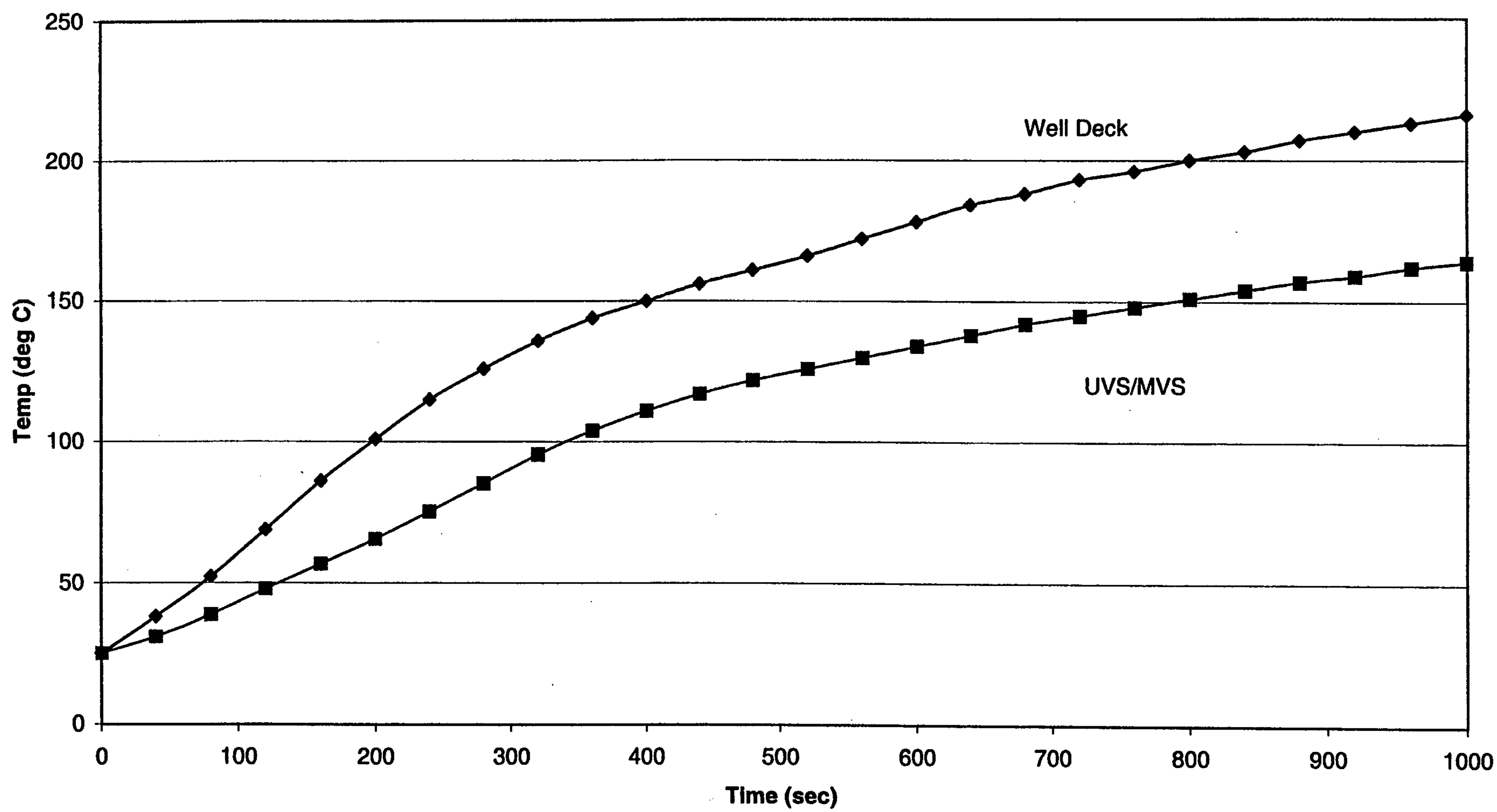
FS	Forward Supply
AE	Aft Exhaust
AS	Aft Supply
MVSA	Main Vehicle Storage Area
UVSA	Upper Vehicle Storage Area
Compartme	Well Deck
Compartme	UVSA/MVSA

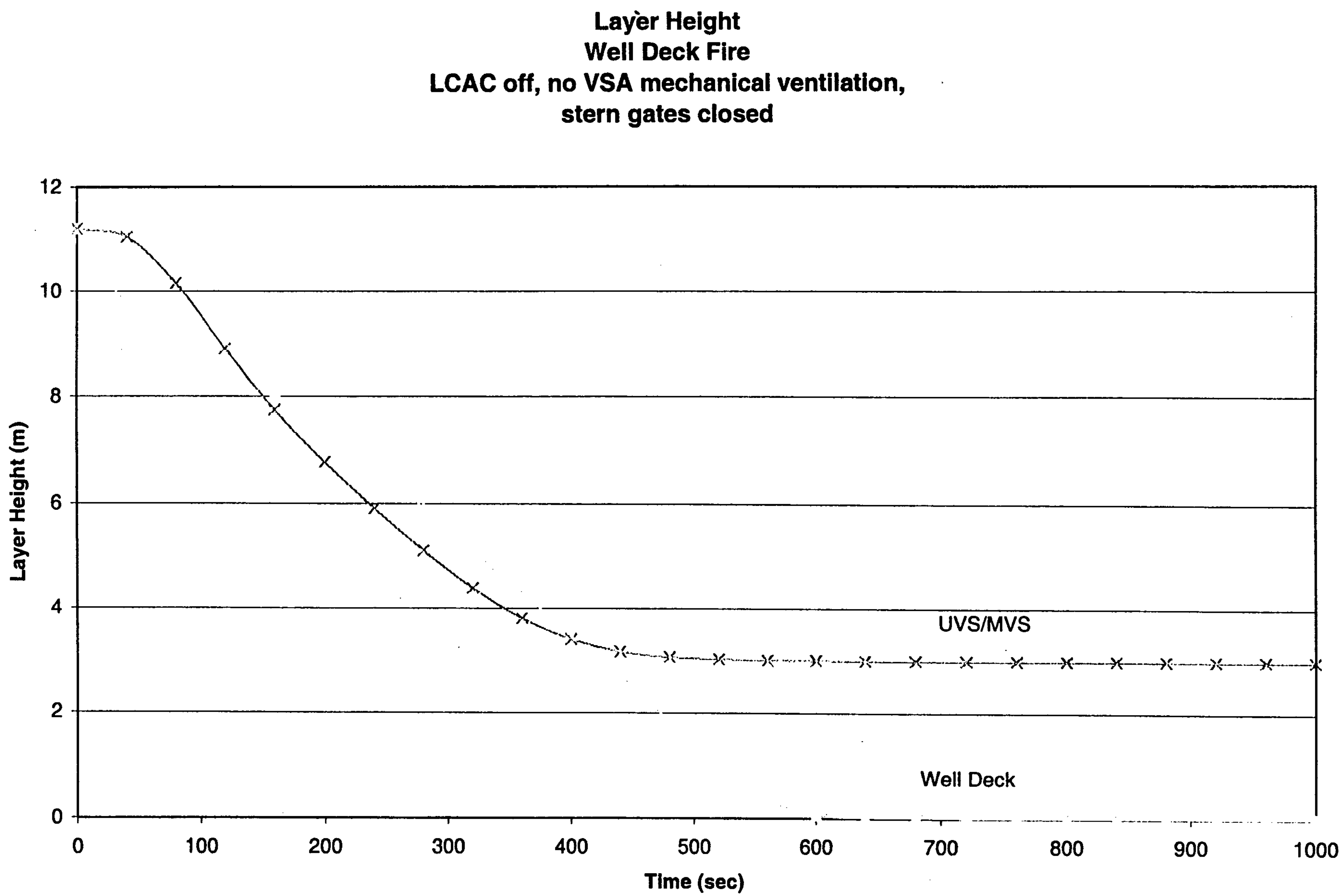
File:	lpd17a.in		
TSG:	closed	**LCAC:**	off
BSG:	closed	**Fans:**	no ventilation
Fire Location:	Well Deck	**Opening:**	1' x 1'

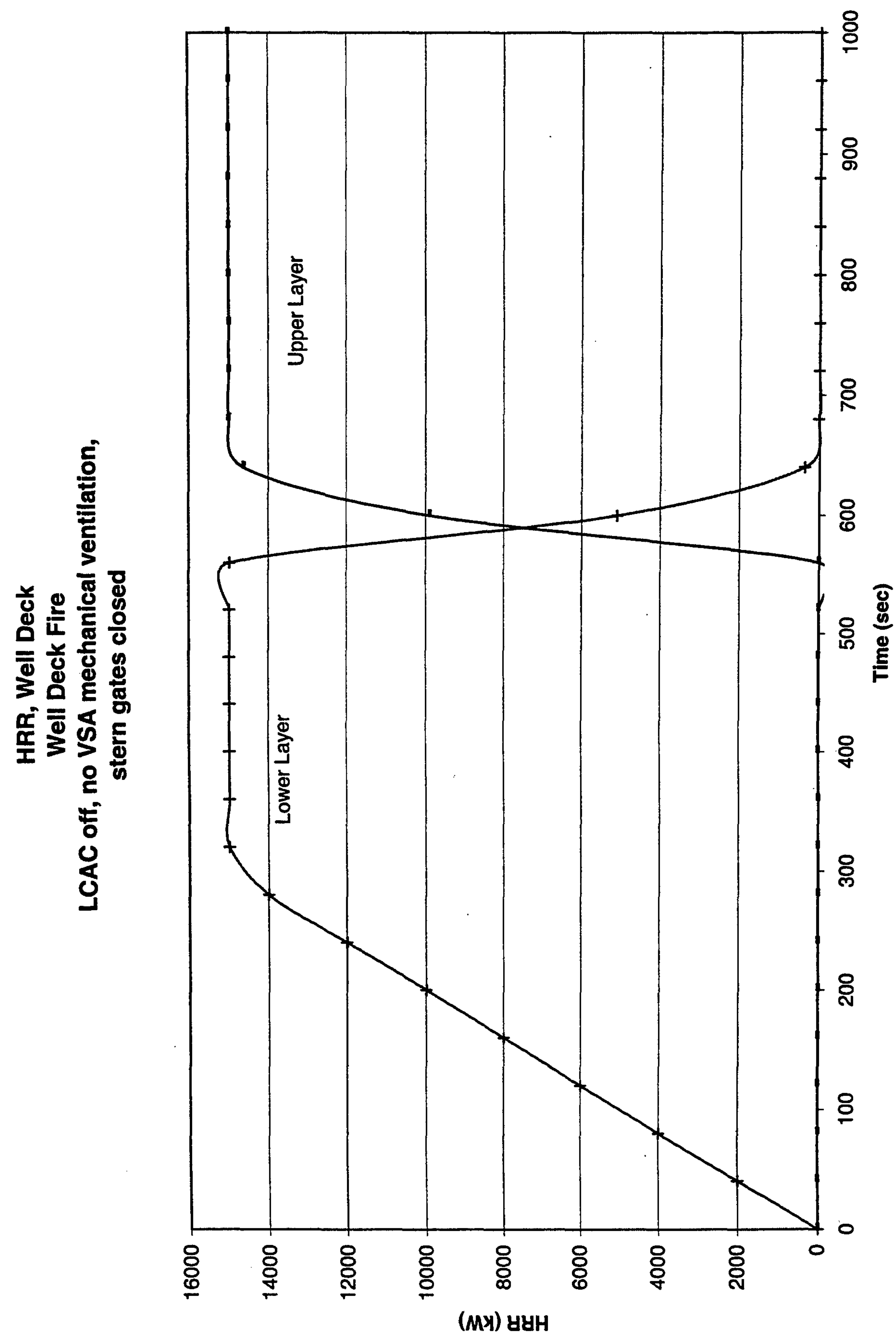
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	38.1	31	9.72	11.04	20.4	20.5	2000	0	0	0
80	52.3	38.8	8.81	10.15	20.2	20.4	4000	0	0	0
120	69	48	8.46	8.91	20	20.3	6000	0	0	0
160	86.3	56.9	8.05	7.75	19.8	20.1	7999	0	0	0
200	101	65.8	7.42	6.77	19.6	20	9999	0	0	0
240	115	75.5	6.73	5.91	19.4	19.9	12000	0	0	0
280	126	85.5	5.93	5.11	19.3	19.7	14000	0	0	0
320	136	95.6	5.1	4.39	19.1	19.6	15000	0	0	0
360	144	104	4.29	3.81	19	19.4	15000	0	0	0
400	150	111	3.51	3.41	18.9	19.3	14990	0	0	0
440	156	117	2.7	3.17	18.7	19.2	14990	0	0	0
480	161	122	1.85	3.07	18.6	19	14990	0	0	0
520	166	126	1.05	3.03	18.4	18.9	14990	0	0	0
560	172	130	0.38	3.01	18.2	18.7	14990	0	0	0
600	178	134	0.06	3.01	18	18.6	5098	0	9894	0
640	184	138	0.02	3	17.8	18.4	365	0	14630	0
680	188	142	0.01	3	17.6	18.2	0	0	15000	0
720	193	145	0	3	17.4	18	0	0	15000	0
760	196	148	0	3	17.2	17.8	0	0	15000	0
800	200	151	0	3	17	17.6	0	0	15000	0
840	203	154	0	3	16.8	17.4	0	0	15000	0
880	207	157	0	3	16.6	17.2	0	0	15000	0
920	210	159	0	3	16.3	17	0	0	15000	0
960	213	162	0	3	16.1	16.8	0	0	15000	0
1000	216	164	0	3	15.9	16.6	0	0	15000	0

```
VERSN    3  Scenario 1
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   .30 .30 0.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17a.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
Well Deck fire
LCAC off, no VSA mechanical ventilation,
stern gates closed




Layer Height
Well Deck Fire
LCAC off, no VSA mechanical ventilation,
stern gates closed
12
10
8
6
4
2
0
Layer Height (m)
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)
UVS/MVS
Well Deck

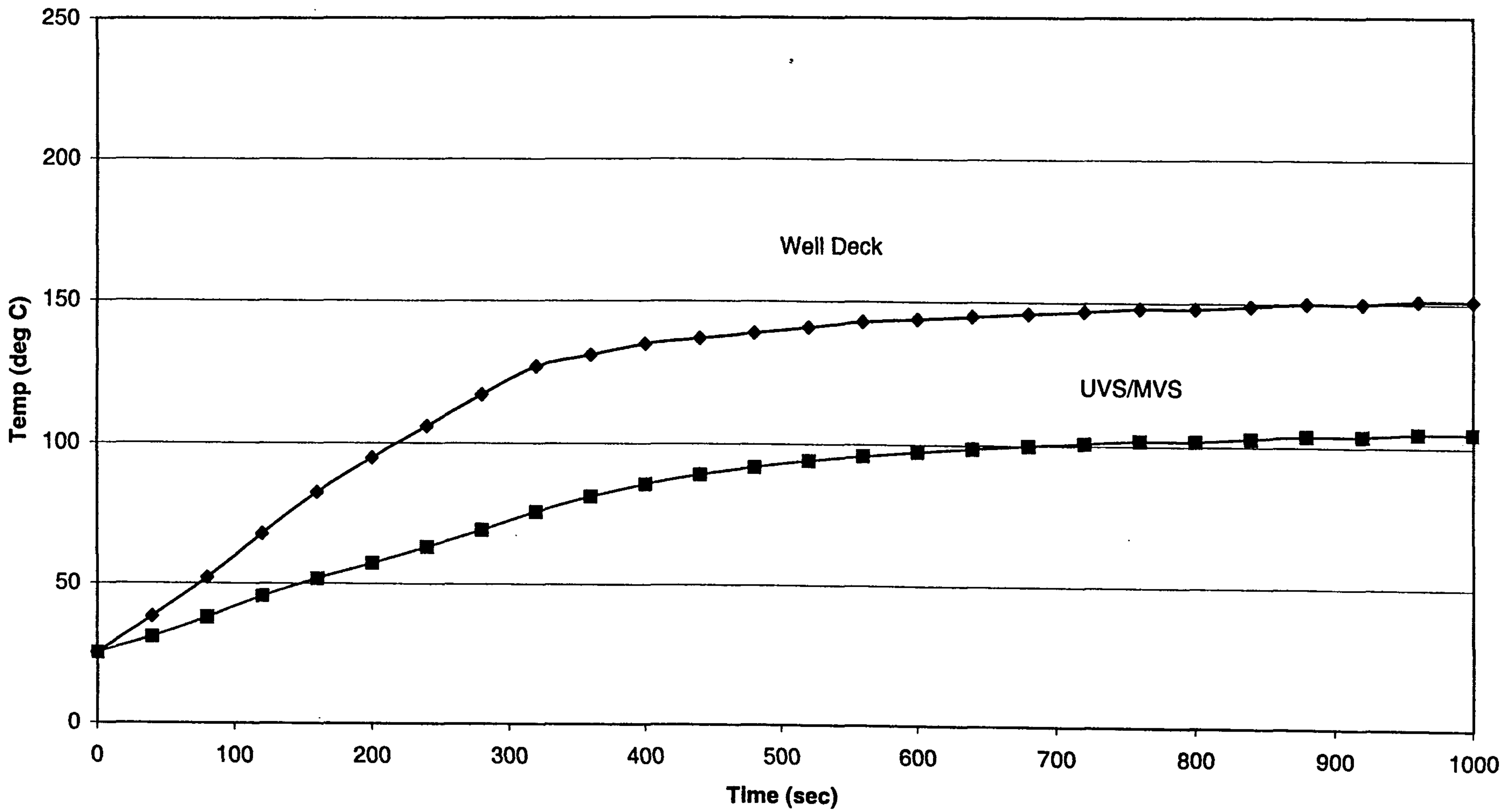

HRR, Well Deck
Well Deck Fire
LCAC off, no VSA mechanical ventilation,
stern gates closed
HRR (kW)
Time (sec)
Lower Layer
Upper Layer
0
2000
4000
6000
8000
10000
12000
14000
16000
0
100
200
300
400
500
600
700
800
900
1000

File:	lpd17d.in		
TSG:	open	**LCAC:**	off
BSG:	closed	**Fans:**	no ventilation
Fire Location:	well deck	**Opening:**	none

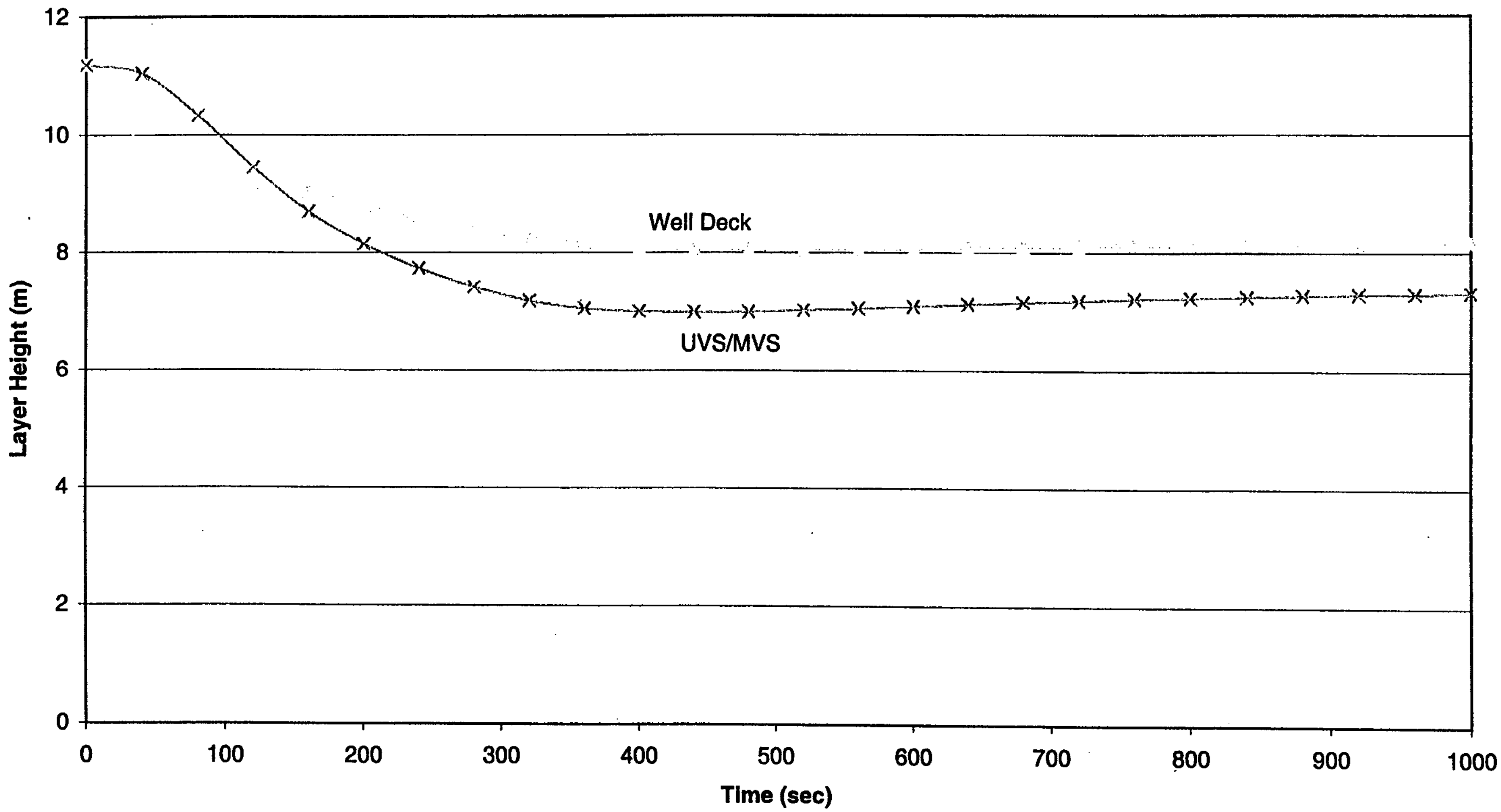
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	38.1	30.8	9.82	11.05	20.4	20.5	2000	0	7.459E-14	0
80	52.1	37.9	9.27	10.33	20.2	20.4	4000	0	7.459E-14	0
120	67.9	45.6	9.2	9.45	20	20.3	6000	0	5.967E-13	0
160	82.7	51.9	9.05	8.7	19.8	20.2	8000	0	5.967E-13	0
200	94.9	57.5	8.8	8.15	19.7	20.1	10000	0	1.193E-12	0
240	106	63.3	8.58	7.73	19.5	20	12000	0	1.193E-12	0
280	117	69.4	8.39	7.41	19.4	19.9	14000	0	1.193E-12	0
320	127	75.9	8.25	7.18	19.3	19.8	15000	0	1.193E-12	0
360	131	81.4	8.15	7.05	19.2	19.7	15000	0	1.193E-12	0
400	135	85.8	8.09	7	19.1	19.6	15000	0	1.193E-12	0
440	137	89.3	8.06	6.99	19.1	19.5	15000	0	1.193E-12	0
480	139	92	8.05	6.99	19.1	19.4	15000	0	1.193E-12	0
520	141	94.3	8.05	7.02	19	19.4	15000	0	1.193E-12	0
560	143	96.1	8.06	7.05	19	19.3	15000	0	1.193E-12	0
600	144	97.6	8.07	7.08	19	19.2	15000	0	1.193E-12	0
640	145	98.9	8.08	7.12	19	19.2	15000	0	1.193E-12	0
680	146	100	8.1	7.15	18.9	19.2	15000	0	1.193E-12	0
720	147	101	8.11	7.18	18.9	19.1	15000	0	1.193E-12	0
760	148	102	8.12	7.21	18.9	19.1	15000	0	1.193E-12	0
800	148	102	8.13	7.23	18.9	19.1	15000	0	1.193E-12	0
840	149	103	8.14	7.25	18.9	19	15000	0	1.193E-12	0
880	150	104	8.15	7.27	18.9	19	15000	0	1.193E-12	0
920	150	104	8.16	7.29	18.9	19	14990	0	1.193E-12	0
960	151	105	8.17	7.3	18.9	19	14990	0	1.193E-12	0
1000	151	105	8.17	7.32	18.9	19	14990	0	1.193E-12	0

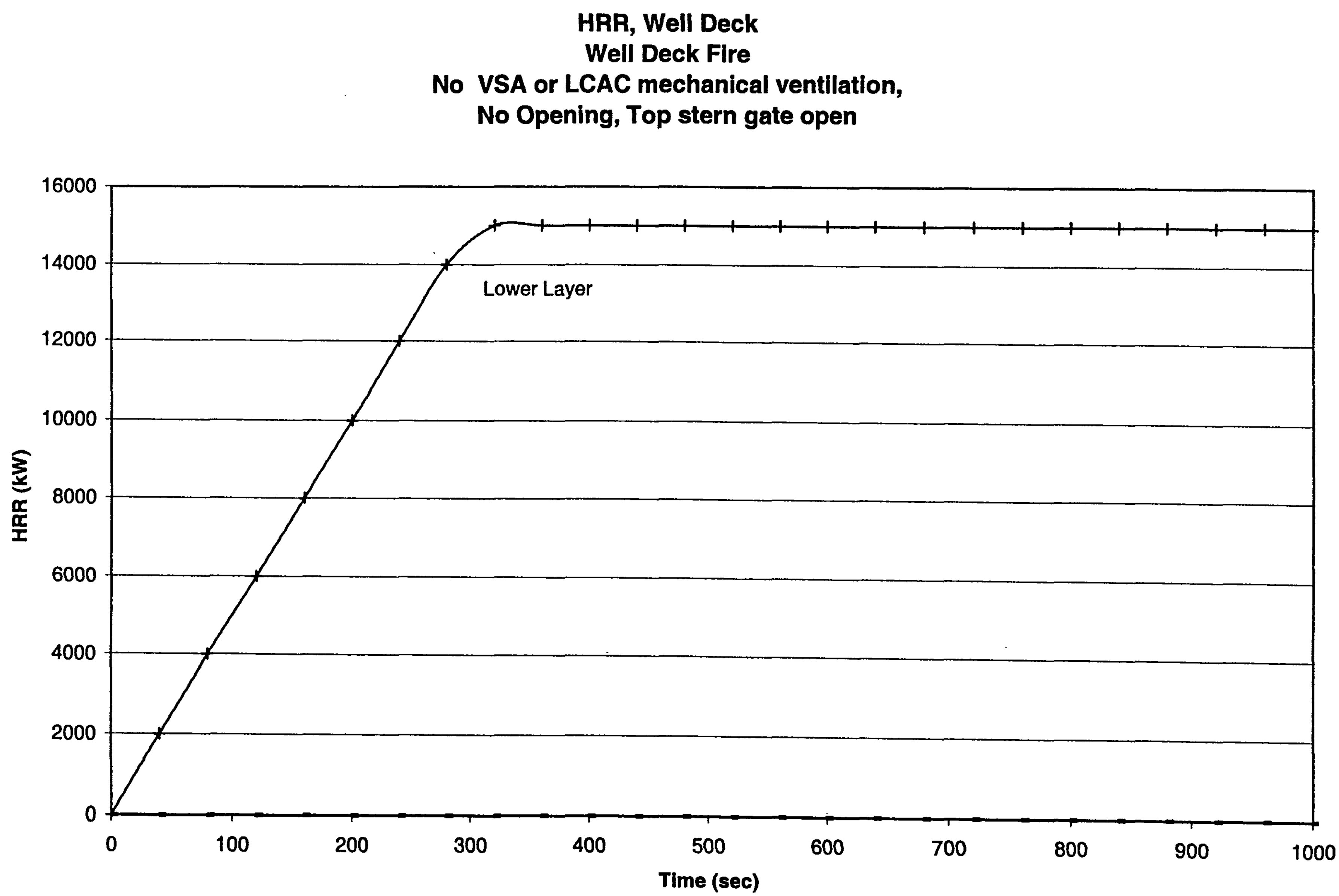
```
VERSN    3  Scenario 2
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   18.5 11.0  6.8
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD     .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17d.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.   300.    0.   600.   920.    10. 5 TIME  METERS
GRAPH   2  740.   300.    0.  1220.  920.    10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
Well Deck Fire
No VSA or LCAC mechanical ventilation, No Opening,
Top stern gate open



Layer Height
Well Deck Fire
No VSA or LCAC mechanical ventilation,
No Opening, Top stern gate open





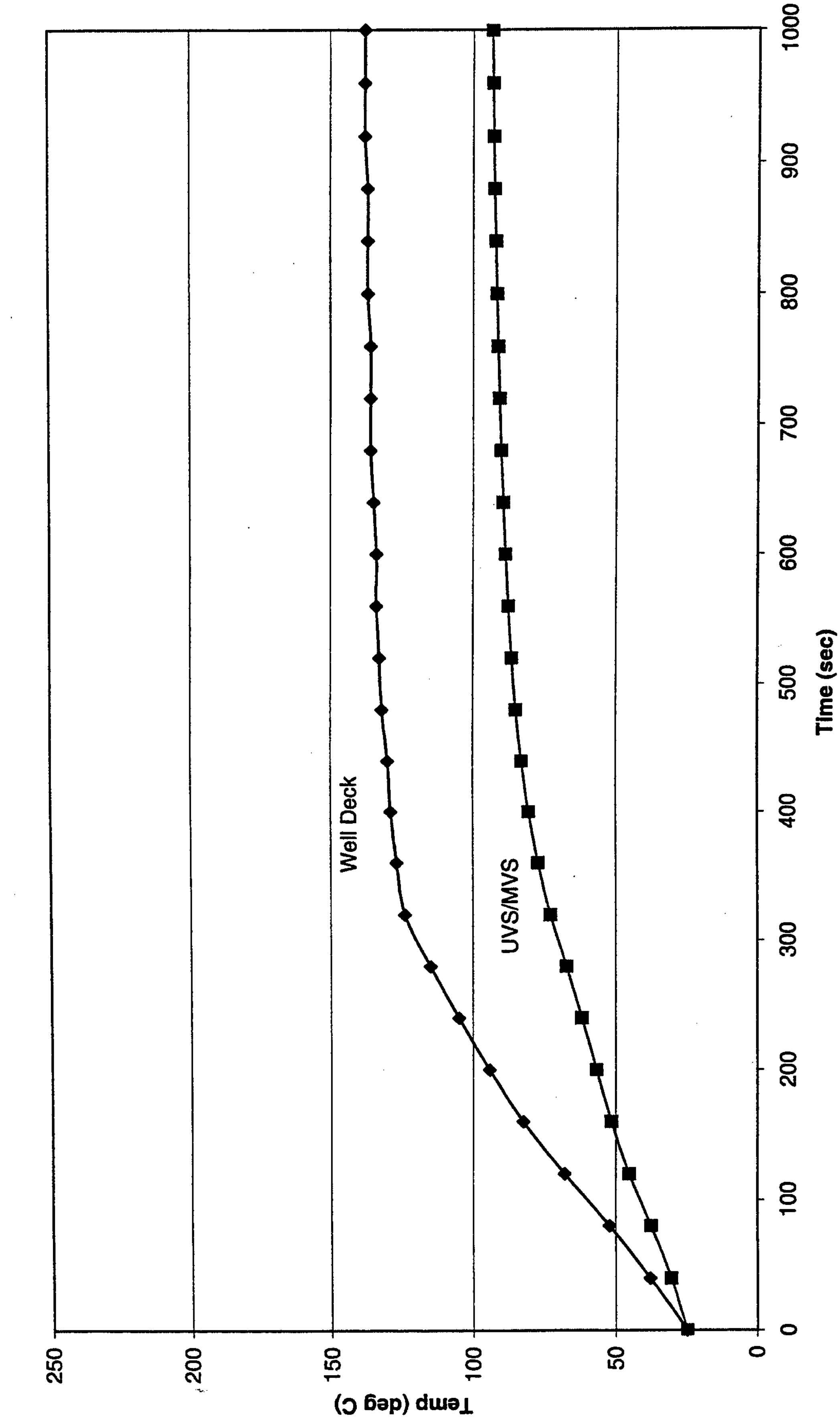
HRR, Well Deck
Well Deck Fire
No VSA or LCAC mechanical ventilation,
No Opening, Top stern gate open
HRR (kW)
16000
14000
12000
10000
8000
6000
4000
2000
0
Lower Layer
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)

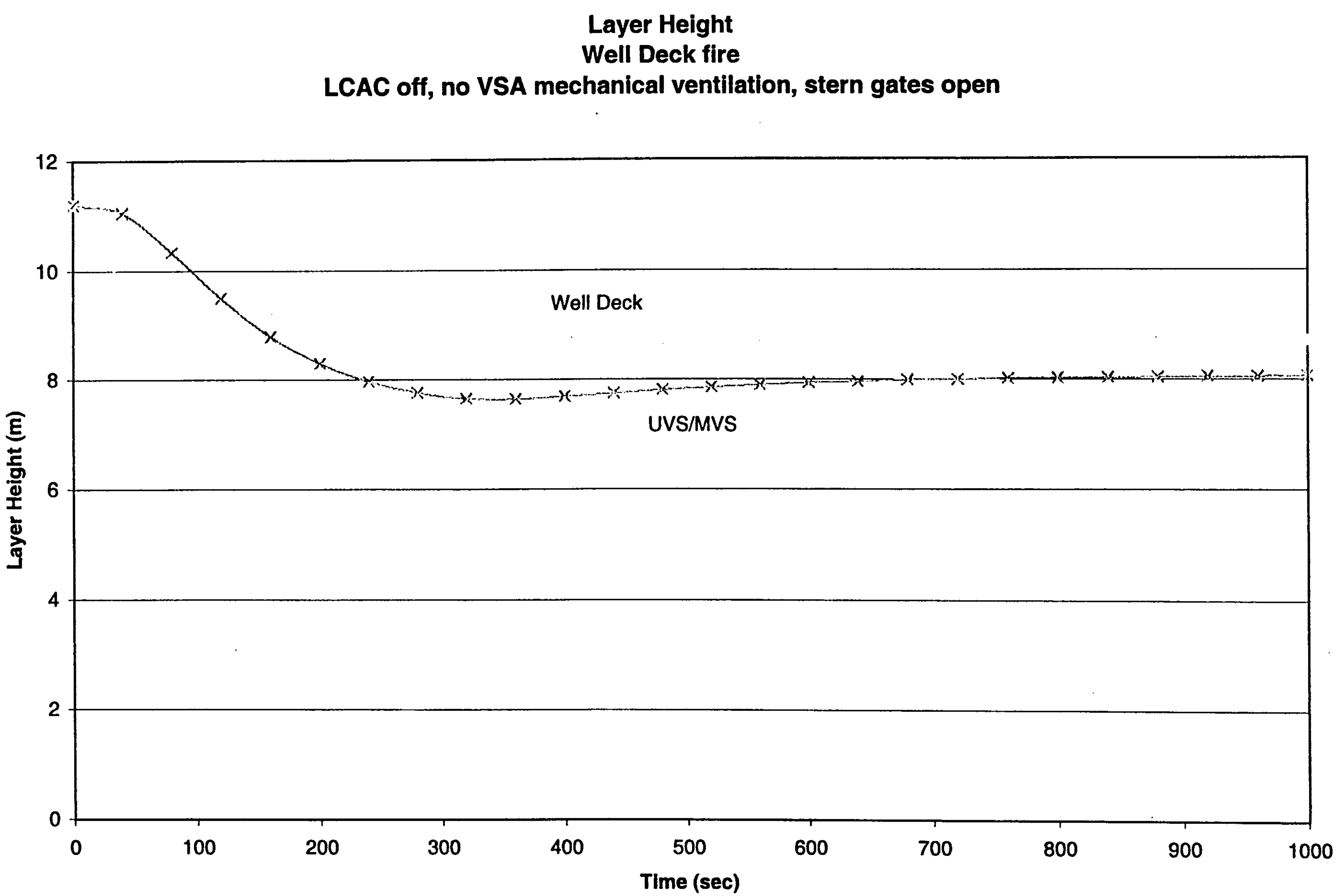
File:	lpd17g.in		
TSG:	open	**LCAC:**	off
BSG:	open	**Fans:**	no ventilation
Fire Location:	well deck	**Opening:**	none

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	38.1	30.8	9.82	11.05	20.4	20.5	2000	0	1.492E-13	0
80	52.2	37.8	9.3	10.34	20.2	20.4	4000	0	1.492E-13	0
120	67.9	45.5	9.26	9.5	20	20.3	6000	0	5.967E-13	0
160	82.4	51.6	9.13	8.79	19.9	20.2	8000	0	5.967E-13	0
200	94.2	56.8	8.94	8.3	19.7	20.1	10000	0	1.193E-12	0
240	105	61.9	8.78	7.97	19.6	20	12000	0	1.193E-12	0
280	115	67.2	8.66	7.76	19.4	19.9	14000	0	1.193E-12	0
320	124	72.8	8.59	7.65	19.3	19.8	15000	0	1.193E-12	0
360	127	77.2	8.56	7.64	19.3	19.7	15000	0	1.193E-12	0
400	129	80.5	8.56	7.69	19.3	19.7	15000	0	1.193E-12	0
440	130	83	8.57	7.75	19.2	19.6	15000	0	1.193E-12	0
480	132	85	8.59	7.81	19.2	19.5	15000	0	1.193E-12	0
520	133	86.5	8.62	7.86	19.2	19.5	15000	0	1.193E-12	0
560	134	87.7	8.63	7.9	19.2	19.4	15000	0	1.193E-12	0
600	134	88.7	8.65	7.94	19.2	19.4	15000	0	1.193E-12	0
640	135	89.5	8.66	7.96	19.2	19.4	15000	0	1.193E-12	0
680	136	90.2	8.67	7.99	19.2	19.3	15000	0	1.193E-12	0
720	136	90.8	8.68	8	19.2	19.3	15000	0	1.193E-12	0
760	136	91.3	8.69	8.02	19.2	19.3	15000	0	1.193E-12	0
800	137	91.7	8.7	8.03	19.2	19.3	15000	0	1.193E-12	0
840	137	92.1	8.71	8.04	19.2	19.3	15000	0	1.193E-12	0
880	137	92.5	8.71	8.05	19.2	19.2	15000	0	1.193E-12	0
920	138	92.8	8.72	8.06	19.2	19.2	15000	0	1.193E-12	0
960	138	93.1	8.72	8.06	19.2	19.2	15000	0	1.193E-12	0
1000	138	93.4	8.73	8.07	19.2	19.2	15000	0	1.193E-12	0

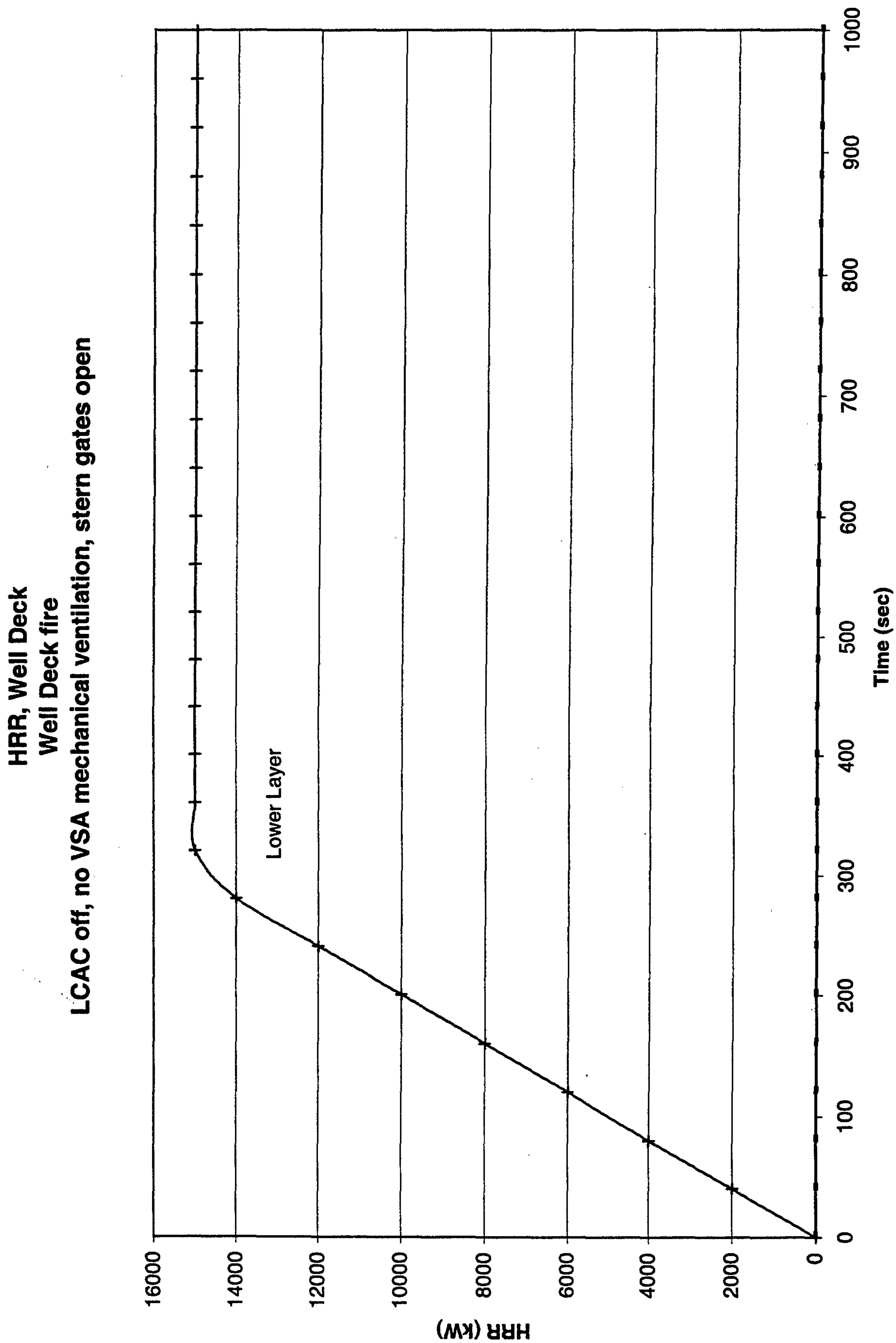
```
VERSN     3  Scenario 3
TIMES 1000  40    40    40     0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   18.5 11.0  0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170 50. 10 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17g.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
Well Deck fire
LCAC off, no VSA mechanical ventilation, stern gates open





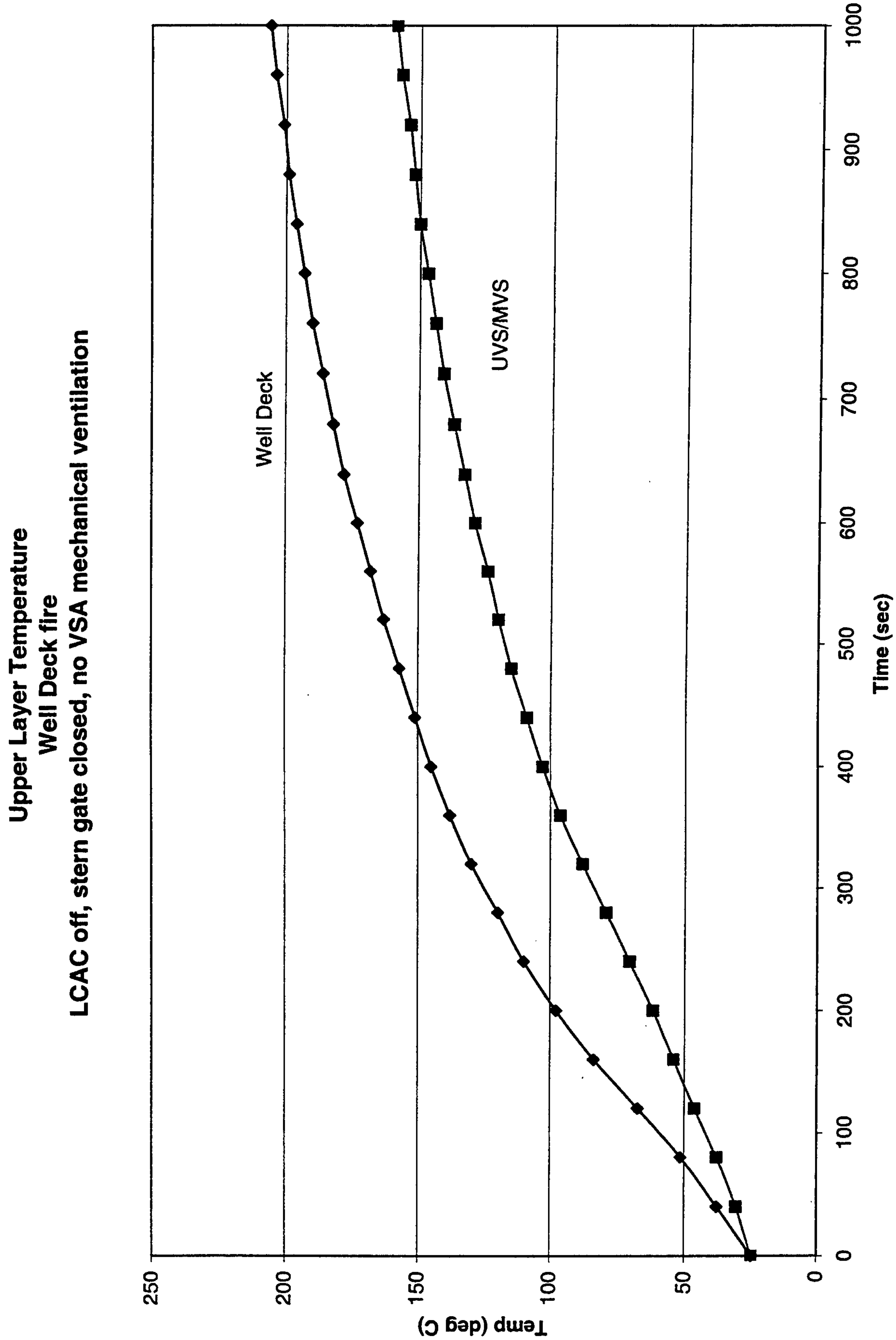
Layer Height
Well Deck fire
LCAC off, no VSA mechanical ventilation, stern gates open
12
10
8
6
4
2
0
Layer Height (m)
Well Deck
UVS/MVS
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)

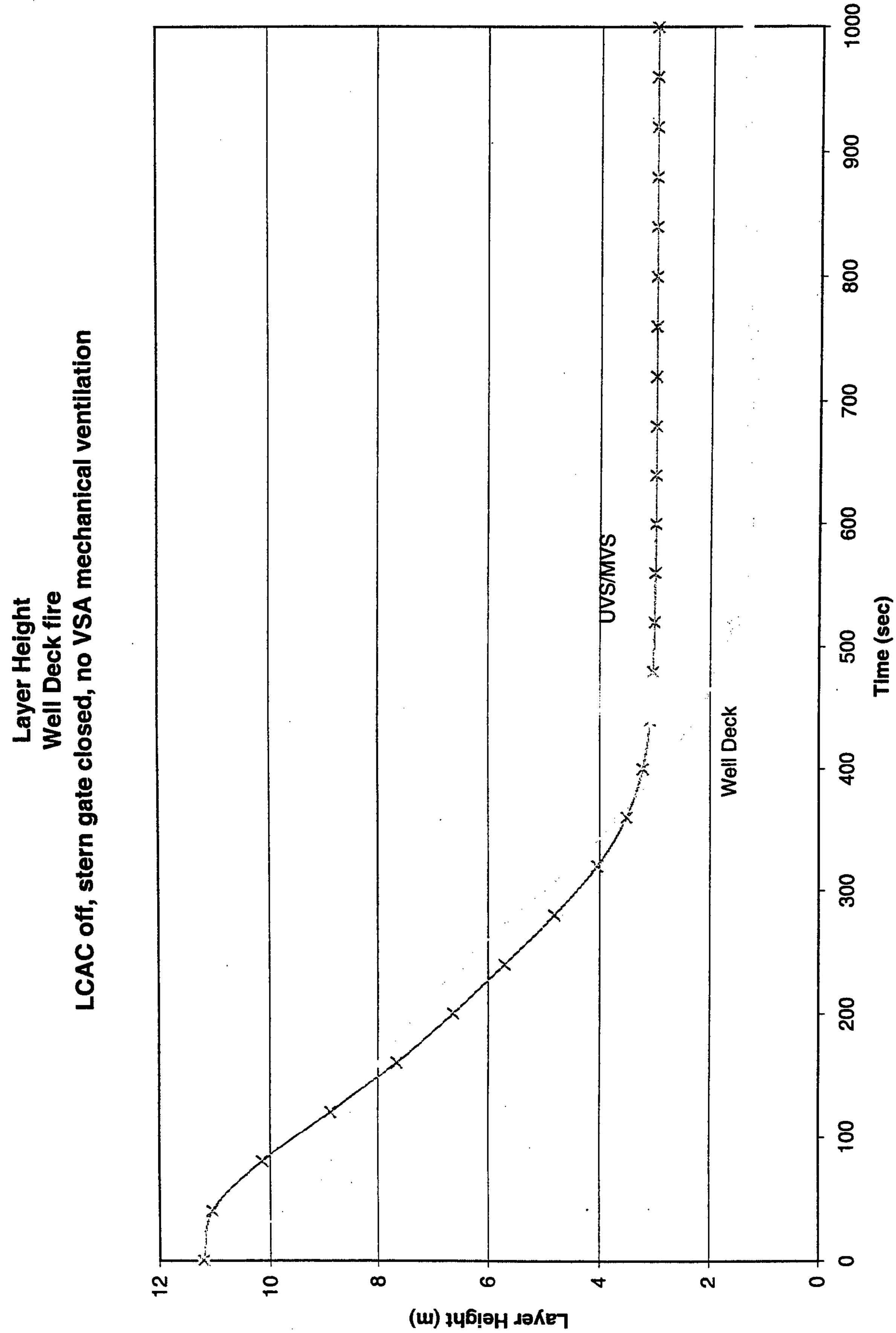

HRR, Well Deck
Well Deck fire
LCAC off, no VSA mechanical ventilation, stern gates open
HRR (kW)
16000
14000
12000
10000
8000
6000
4000
2000
0
Time (sec)
0
100
200
300
400
500
600
700
800
900
1000
Lower Layer

File:	lpd17j.in		
TSG:	closed	**LCAC:**	off
BSG:	closed	**Fans:**	no ventilation
Fire Location:	well deck	**Opening:**	2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	37.9	30.8	9.72	11.04	20.4	20.5	2000	0	9.324E-15	0
80	51.5	38	8.79	10.15	20.2	20.4	4000	0	9.324E-15	0
120	67.4	46.3	8.42	8.88	20	20.3	6000	0	5.967E-13	0
160	83.8	54.2	7.97	7.67	19.8	20.1	8000	0	5.967E-13	0
200	97.8	62	7.28	6.64	19.6	20	10000	0	1.193E-12	0
240	110	70.5	6.47	5.7	19.4	19.9	12000	0	1.193E-12	0
280	120	79.3	5.52	4.82	19.3	19.7	14000	0	1.193E-12	0
320	130	88.1	4.51	4.05	19.1	19.6	15000	0	1.193E-12	0
360	138	96.3	3.65	3.514	18.9	19.4	15000	0	1.193E-12	0
400	145	103	2.92	3.216	18.8	19.2	15000	0	1.193E-12	0
440	151	109	2.3	3.08925	18.6	19.1	15000	0	1.193E-12	0
480	157	115	1.86	3.03747	18.5	18.9	15000	0	1.193E-12	0
520	163	120	1.58	3.01588	18.3	18.8	15000	0	1.193E-12	0
560	168	124	1.41	3.006763	18.1	18.6	14990	0	1.193E-12	0
600	173	129	1.32	3.00289	18	18.5	14990	0	1.193E-12	0
640	178	133	1.27	3.001238	17.8	18.3	14990	0	1.193E-12	0
680	182	137	1.26	3.0006757	17.6	18.2	14990	0	1.193E-12	0
720	186	141	1.26	3.0006757	17.5	18	14990	0	1.193E-12	0
760	190	144	1.28	3.0006757	17.3	17.8	14990	0	1.193E-12	0
800	193	147	1.29	3.0006757	17.2	17.7	14990	0	1.193E-12	0
840	196	150	1.31	3.0006757	17	17.5	14990	0	1.193E-12	0
880	199	152	1.33	3.0006757	16.9	17.4	14980	0	1.193E-12	0
920	201	154	1.35	3.0006757	16.8	17.2	14980	0	1.193E-12	0
960	204	157	1.37	3.0006757	16.6	17.1	14980	0	1.193E-12	0
1000	206	159	1.39	3.0006757	16.5	16.9	14980	0	1.193E-12	0

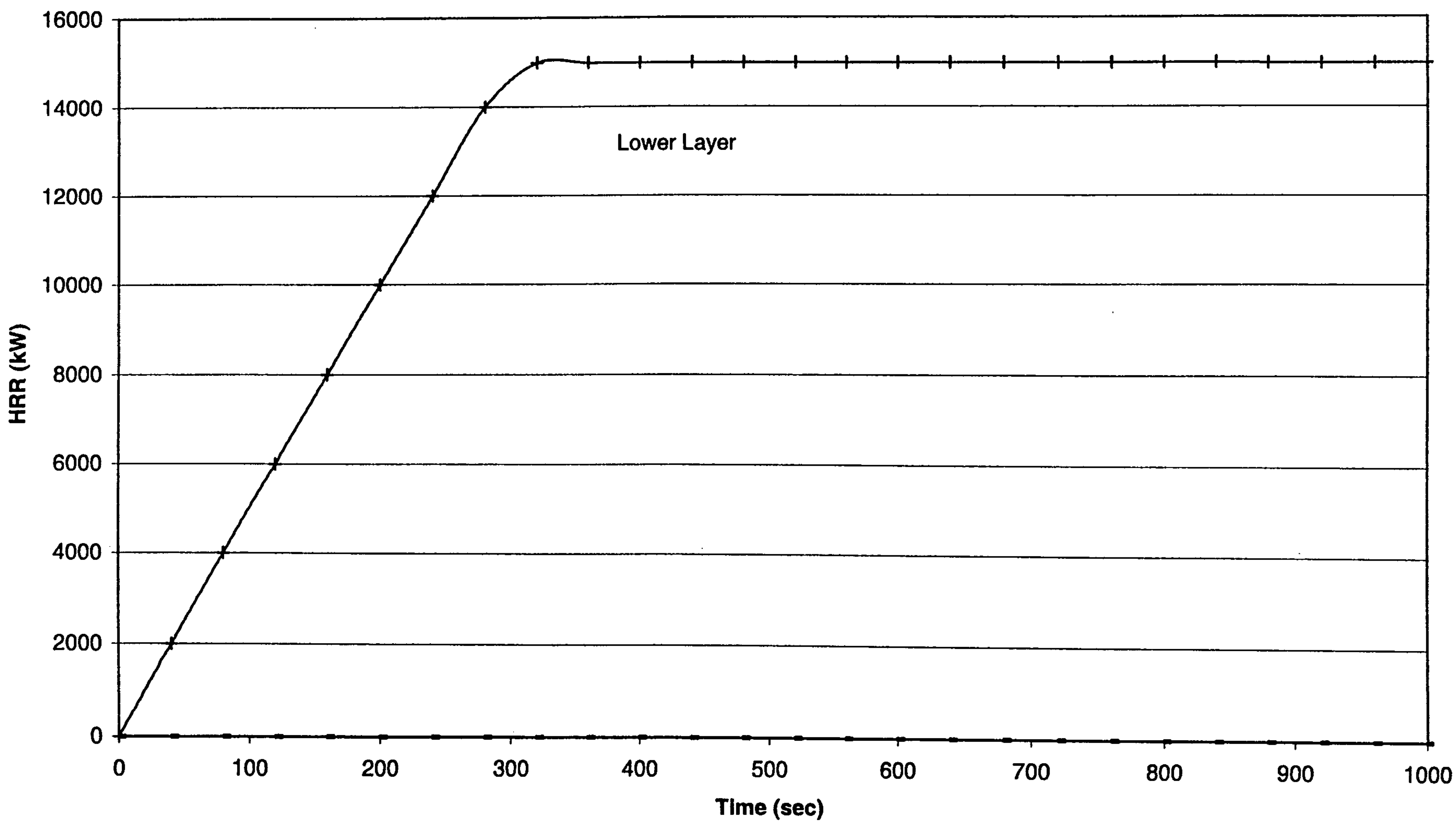
```
VERSN     3  Scenario 4
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17j.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```


Upper Layer Temperature
Well Deck fire
LCAC off, stern gate closed, no VSA mechanical ventilation
Well Deck
UVS/MVS
Temp (deg C)
Time (sec)
0
50
100
150
200
250
0
100
200
300
400
500
600
700
800
900
1000



Layer Height
Well Deck fire
LCAC off, stern gate closed, no VSA mechanical ventilation
Layer Height (m)
Time (sec)
UVS/MVS
Well Deck
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000

HRR Well Deck
Well Deck fire
LCAC off, stern gate closed, no VSA mechanical ventilation



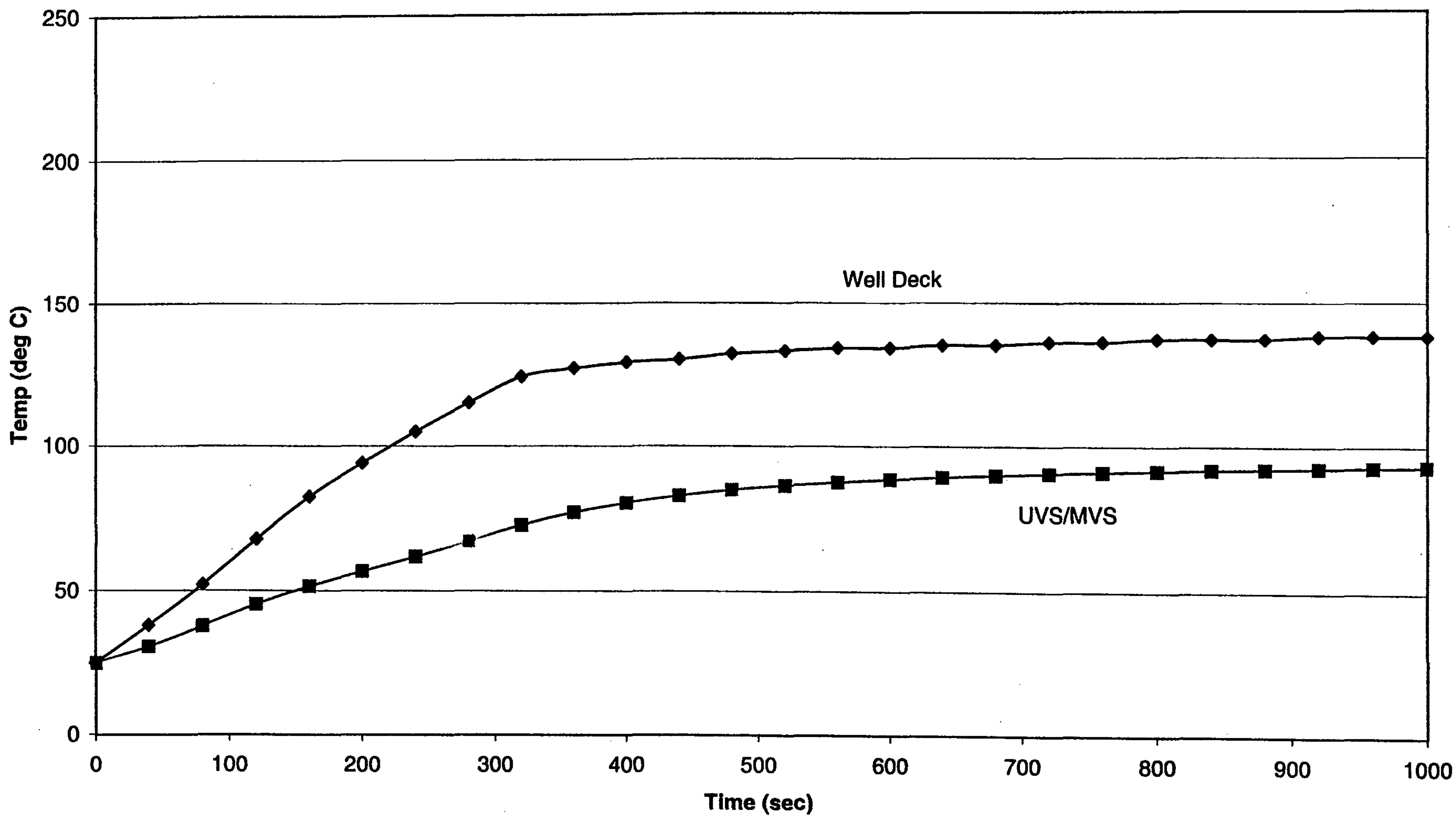
File: lpd17m.in
TSG: open
BSG: open
Fire Location: well deck

LCAC: off
Fans: no ventilation
Opening: 2.8 x 5.0

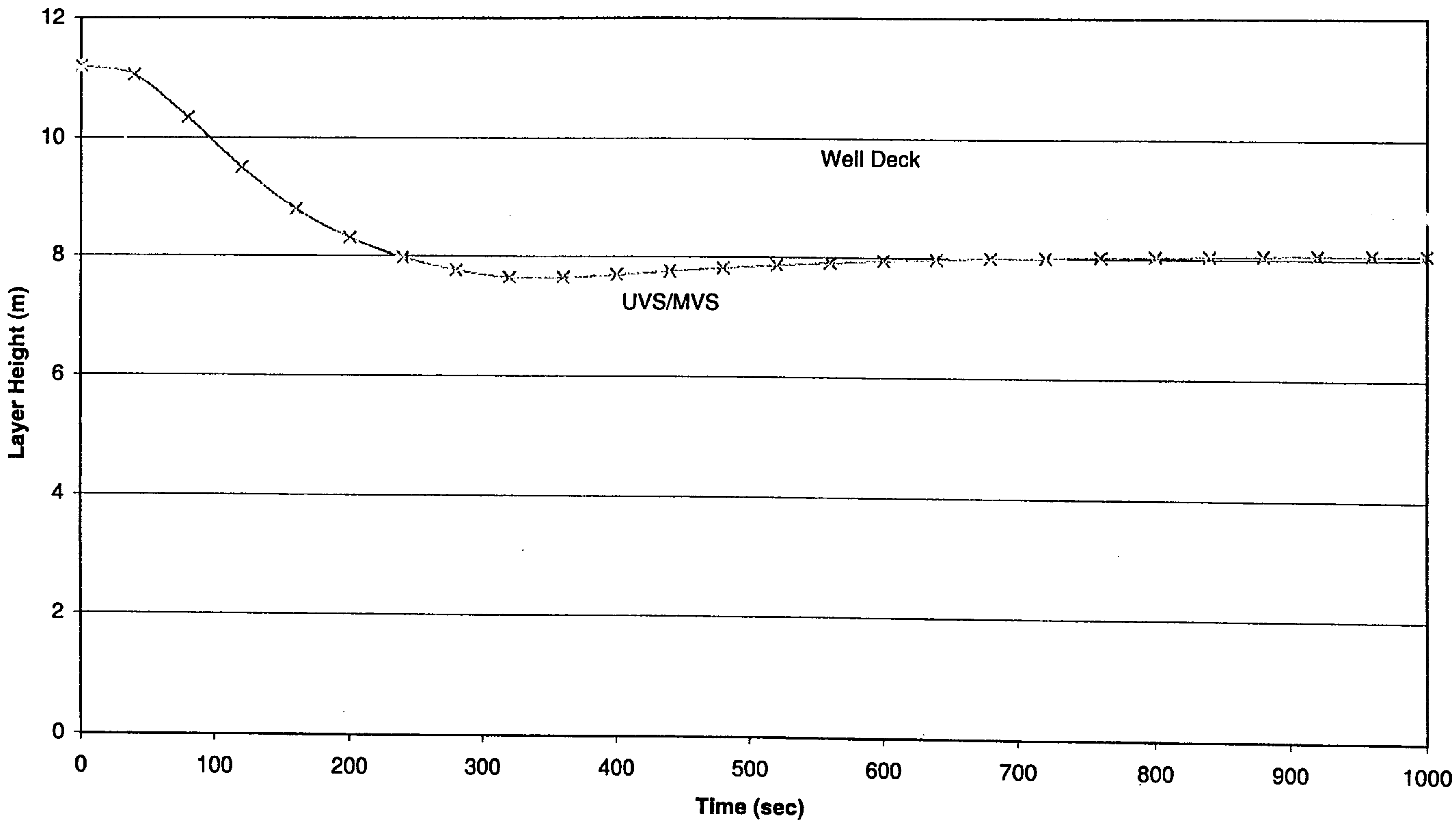
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.00	25.00	25.00	11.20	11.20	20.60	20.60	0.00	0.00	0.00	0.00
40.00	38.10	30.80	9.82	11.05	20.40	20.50	2000.00	0.00	0.00	0.00
80.00	52.20	37.80	9.30	10.34	20.20	20.40	4000.00	0.00	0.00	0.00
120.00	67.90	45.40	9.26	9.50	20.00	20.30	6000.00	0.00	0.00	0.00
160.00	82.40	51.60	9.14	8.79	19.90	20.20	8000.00	0.00	0.00	0.00
200.00	94.10	56.80	8.94	8.31	19.70	20.10	10000.00	0.00	0.00	0.00
240.00	105.00	61.90	8.78	7.98	19.60	20.00	12000.00	0.00	0.00	0.00
280.00	115.00	67.20	8.67	7.77	19.40	19.90	14000.00	0.00	0.00	0.00
320.00	124.00	72.70	8.60	7.65	19.30	19.80	15000.00	0.00	0.00	0.00
360.00	127.00	77.20	8.57	7.65	19.30	19.70	15000.00	0.00	0.00	0.00
400.00	129.00	80.40	8.57	7.70	19.30	19.70	15000.00	0.00	0.00	0.00
440.00	130.00	82.90	8.58	7.76	19.20	19.60	15000.00	0.00	0.00	0.00
480.00	132.00	84.90	8.60	7.82	19.20	19.50	15000.00	0.00	0.00	0.00
520.00	133.00	86.40	8.62	7.87	19.20	19.50	15000.00	0.00	0.00	0.00
560.00	134.00	87.60	8.64	7.91	19.20	19.40	15000.00	0.00	0.00	0.00
600.00	134.00	88.60	8.66	7.95	19.20	19.40	15000.00	0.00	0.00	0.00
640.00	135.00	89.40	8.67	7.98	19.20	19.40	15000.00	0.00	0.00	0.00
680.00	135.00	90.10	8.68	8.00	19.20	19.30	15000.00	0.00	0.00	0.00
720.00	136.00	90.70	8.69	8.01	19.20	19.30	15000.00	0.00	0.00	0.00
760.00	136.00	91.20	8.70	8.03	19.20	19.30	15000.00	0.00	0.00	0.00
800.00	137.00	91.60	8.71	8.04	19.20	19.30	15000.00	0.00	0.00	0.00
840.00	137.00	92.00	8.71	8.05	19.20	19.30	15000.00	0.00	0.00	0.00
880.00	137.00	92.30	8.72	8.06	19.20	19.20	15000.00	0.00	0.00	0.00
920.00	138.00	92.60	8.72	8.07	19.20	19.20	15000.00	0.00	0.00	0.00
960.00	138.00	92.90	8.73	8.08	19.20	19.20	15000.00	0.00	0.00	0.00
1000.00	138.00	93.20	8.74	8.08	19.20	19.20	15000.00	0.00	0.00	0.00

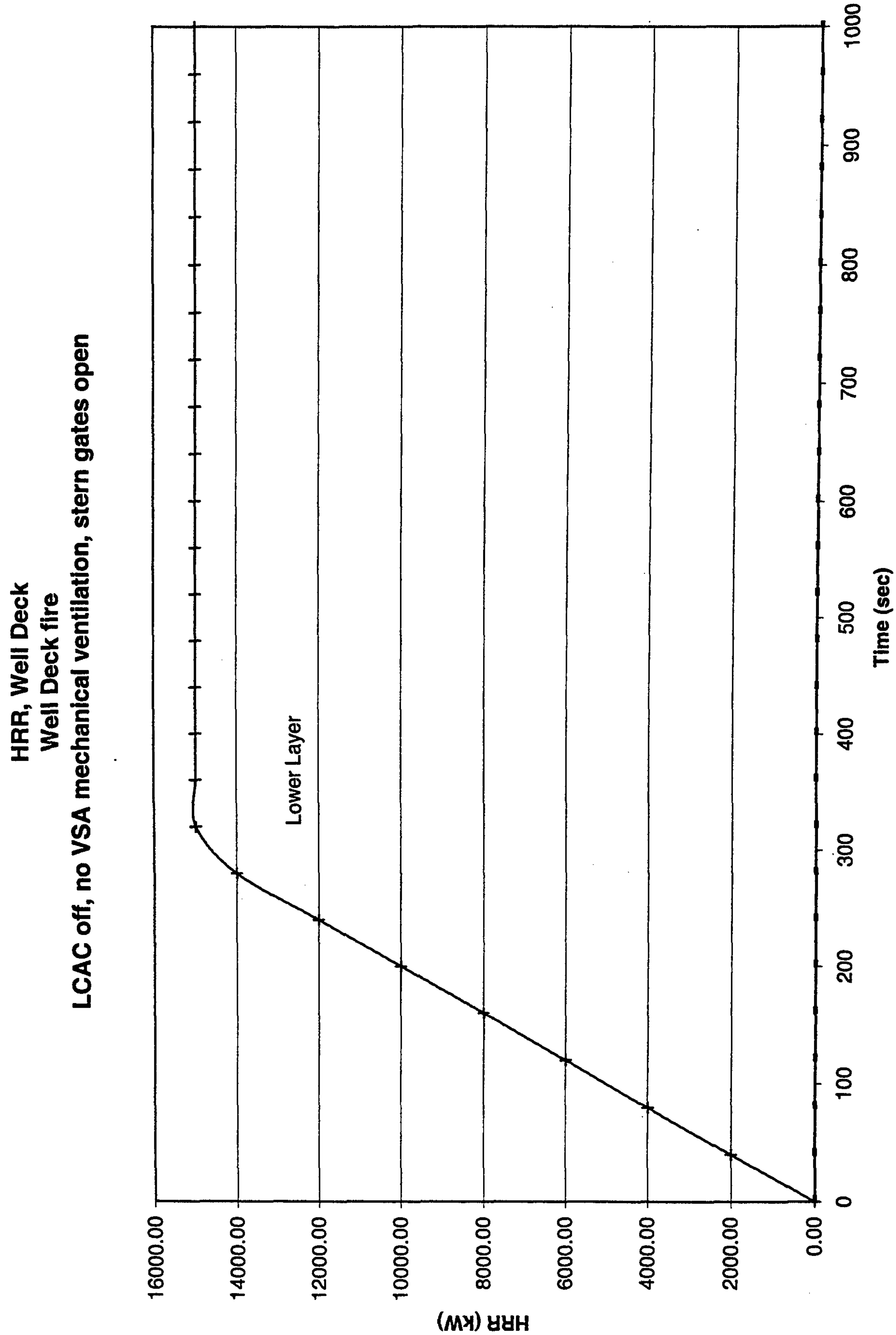
```
VERSN     3  Scenario 5
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   18.5 11.0  0
HVENT  1  3  2   2.8  5.0  0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17m.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER    0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
Well Deck fire
LCAC off, no VSA mechanical ventilation, stern gates open



Layer Height
Well Deck fire
LCAC off, no VSA mechanical ventilation, stern gates open



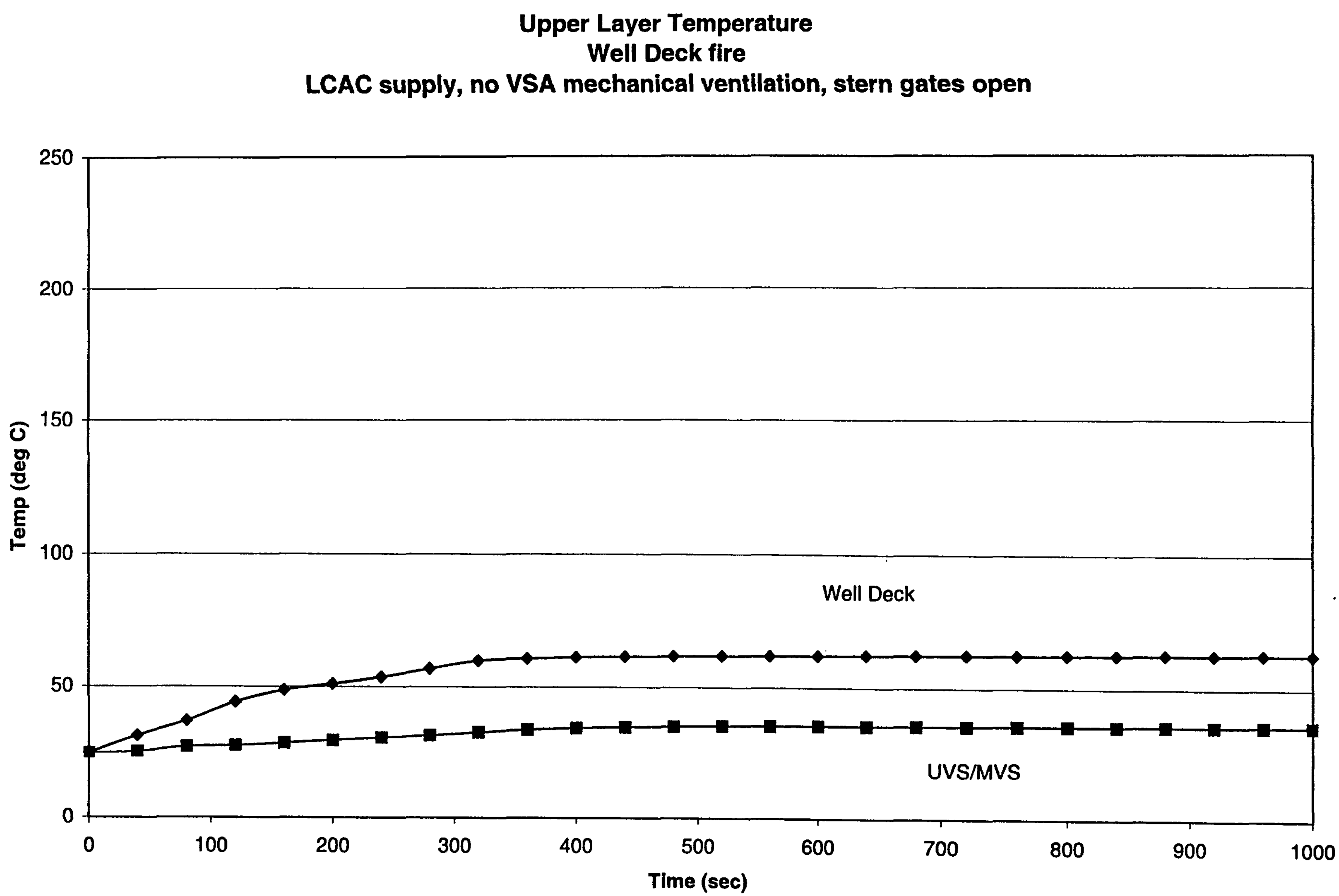

HRR, Well Deck
Well Deck fire
LCAC off, no VSA mechanical ventilation, stern gates open
Lower Layer
HRR (kW)
Time (sec)
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
0
100
200
300
400
500
600
700
800
900
1000

File: lpd17hhh.in
TSG: open
BSG: open
Fire Location: well deck

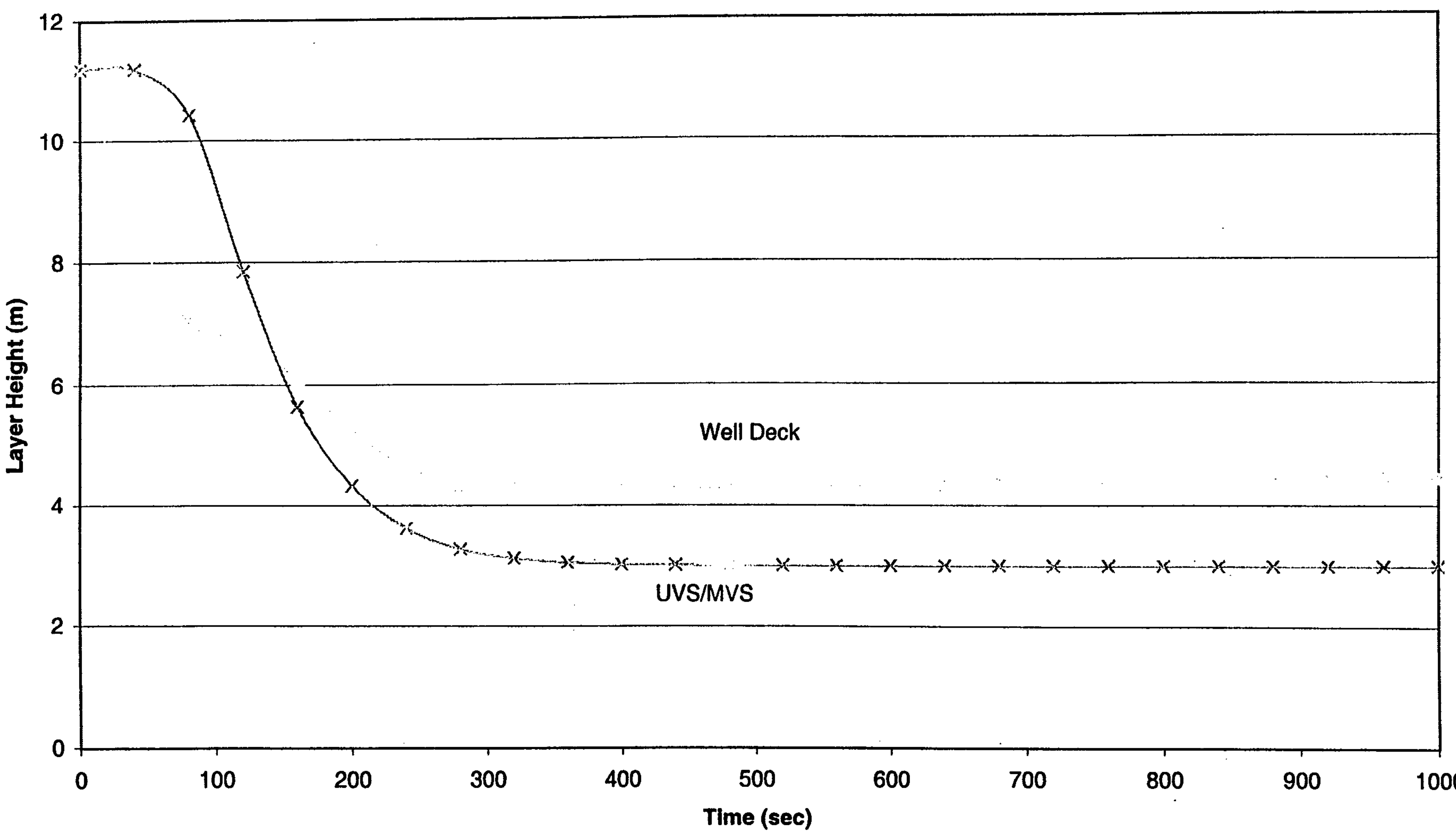
LCAC: supply
Fans: no ventilation
Opening: 2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	31.6	25.5	8.65	11.19	20.4	20.5	2000	0	0	0
80	37.2	27.4	7.01	10.42	20.3	20.4	4000	0	0	0
120	44.3	27.9	6.75	7.85	20.2	20.4	6000	0	0	0
160	48.7	28.9	6.09	5.64	20.1	20.4	8000	0	0	0
200	51.1	29.9	5.22	4.33	20.1	20.3	10000	0	0	0
240	53.7	30.9	4.63	3.62	20.1	20.3	12000	0	0	0
280	56.9	31.9	4.35	3.27	20	20.3	14000	0	0	0
320	59.9	33.1	4.27	3.12	20	20.3	15000	0	0	0
360	60.8	34.1	4.27	3.05	20	20.3	15000	0	0	0
400	61.3	34.7	4.28	3.02	20	20.3	15000	0	0	0
440	61.6	35.1	4.29	3.01	20	20.3	15000	0	0	0
480	61.8	35.4	4.3	3	20	20.3	15000	0	0	0
520	62	35.6	4.32	3	20	20.3	15000	0	0	0
560	62.1	35.7	4.33	3	20	20.3	15000	0	0	0
600	62.2	35.8	4.34	3	20	20.3	15000	0	0	0
640	62.3	35.8	4.36	3	20	20.3	15000	0	0	0
680	62.4	35.9	4.37	3	20	20.3	15000	0	0	0
720	62.5	35.9	4.38	3	20	20.3	15000	0	0	0
760	62.5	36	4.39	3	20	20.3	15000	0	0	0
800	62.6	36	4.4	3	20	20.3	15000	0	0	0
840	62.7	36	4.41	3	20	20.3	15000	0	0	0
880	62.8	36.1	4.42	3	20	20.3	15000	0	0	0
920	62.8	36.1	4.43	3	20	20.3	15000	0	0	0
960	62.9	36.1	4.44	3	20	20.3	15000	0	0	0
1000	62.9	36.1	4.45	3	20	20.3	15000	0	0	0

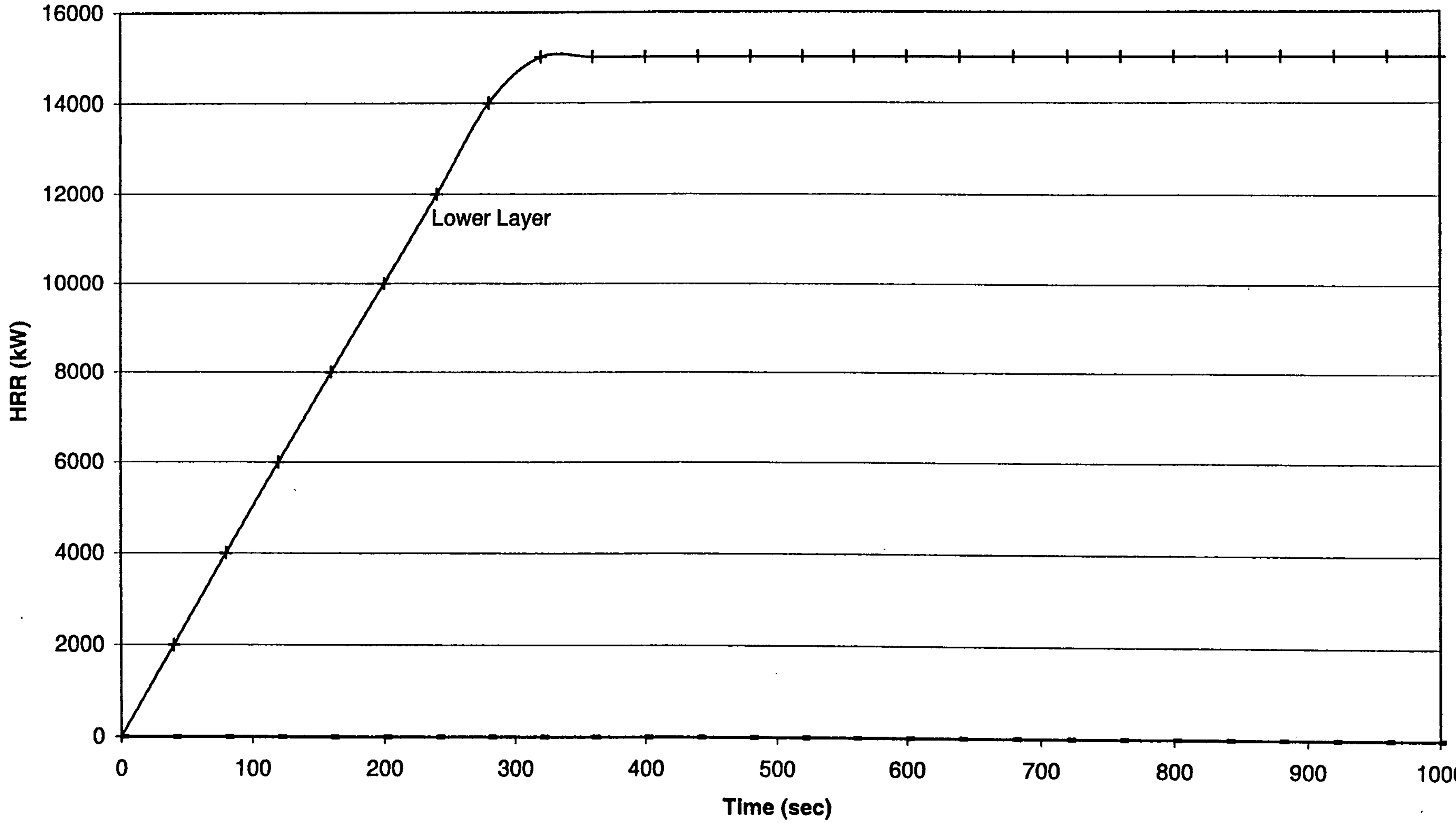
```
VERSN    3   Scenario 6
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.2  0.0
MVOPN  2  1 V   8.2  4.0
MVOPN  3  4 V  8.2  4.0
MVOPN  1  5 V  11.2  4.0
MVOPN  3  8 V  11.2  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2  0.0  1000. 90
MVFAN  7  6   0.0  1000. 90
INELV    1   11.2  2   11.2  3  11.2  4   11.2
INELV    5   11.2  6   11.2  7  11.2  8   11.2
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17hhh.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```


Upper Layer Temperature
Well Deck fire
LCAC supply, no VSA mechanical ventilation, stern gates open
Temp (deg C)
250
200
150
100
50
0
Time (sec)
0
100
200
300
400
500
600
700
800
900
1000
Well Deck
UVS/MVS

Layer Height
Well Deck fire
LCAC supply, no VSA mechanical ventilation, stern gates open



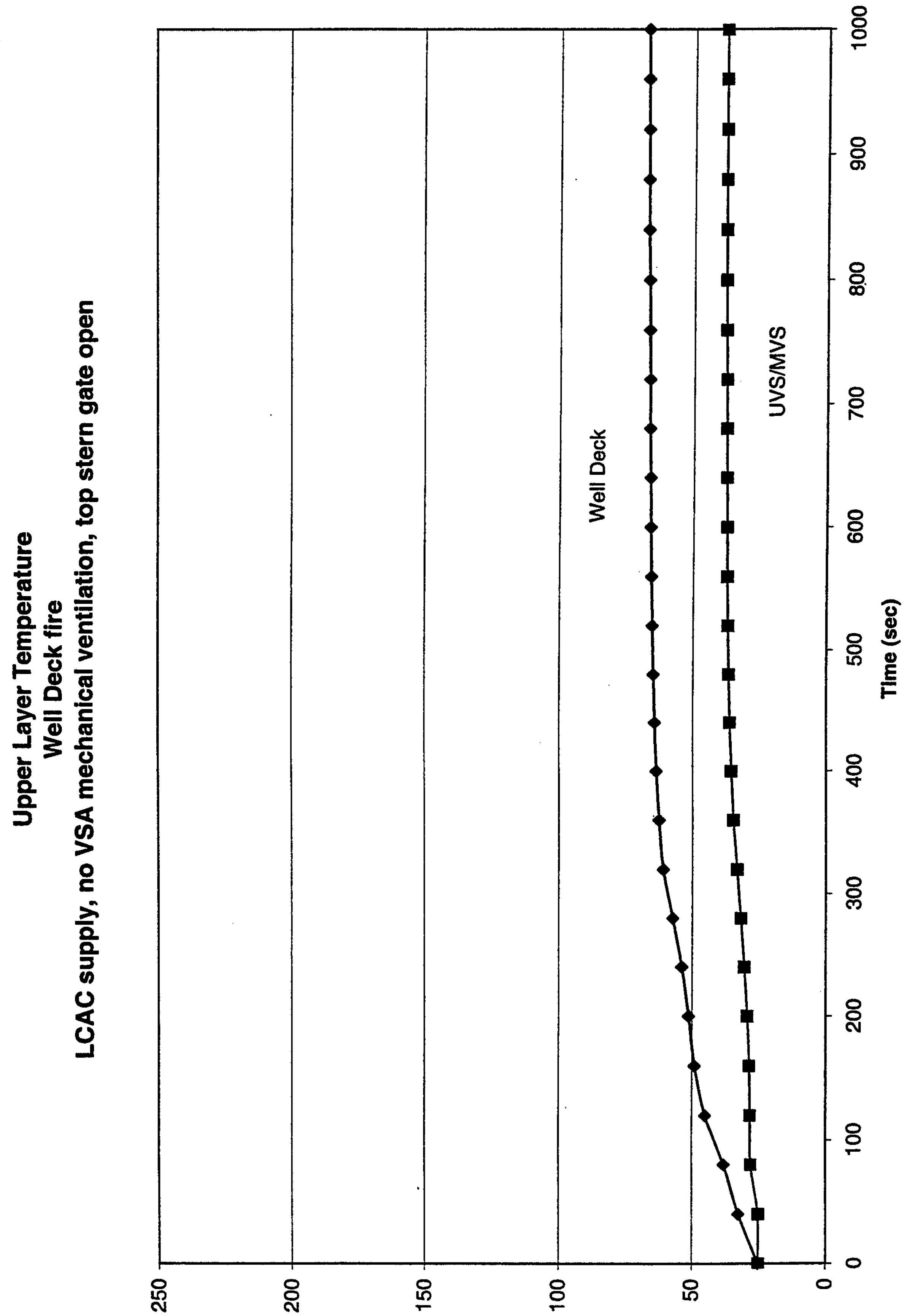
HRR, Well Deck
Well Deck fire
LCAC supply, no VSA mechanical ventilation, stern gates open



File:	lpd17lll.in		
TSG:	open	**LCAC:**	supply
BSG:	closed	**Fans:**	no ventilation
Fire Location:	well deck	**Opening:**	2.8 x 5.0

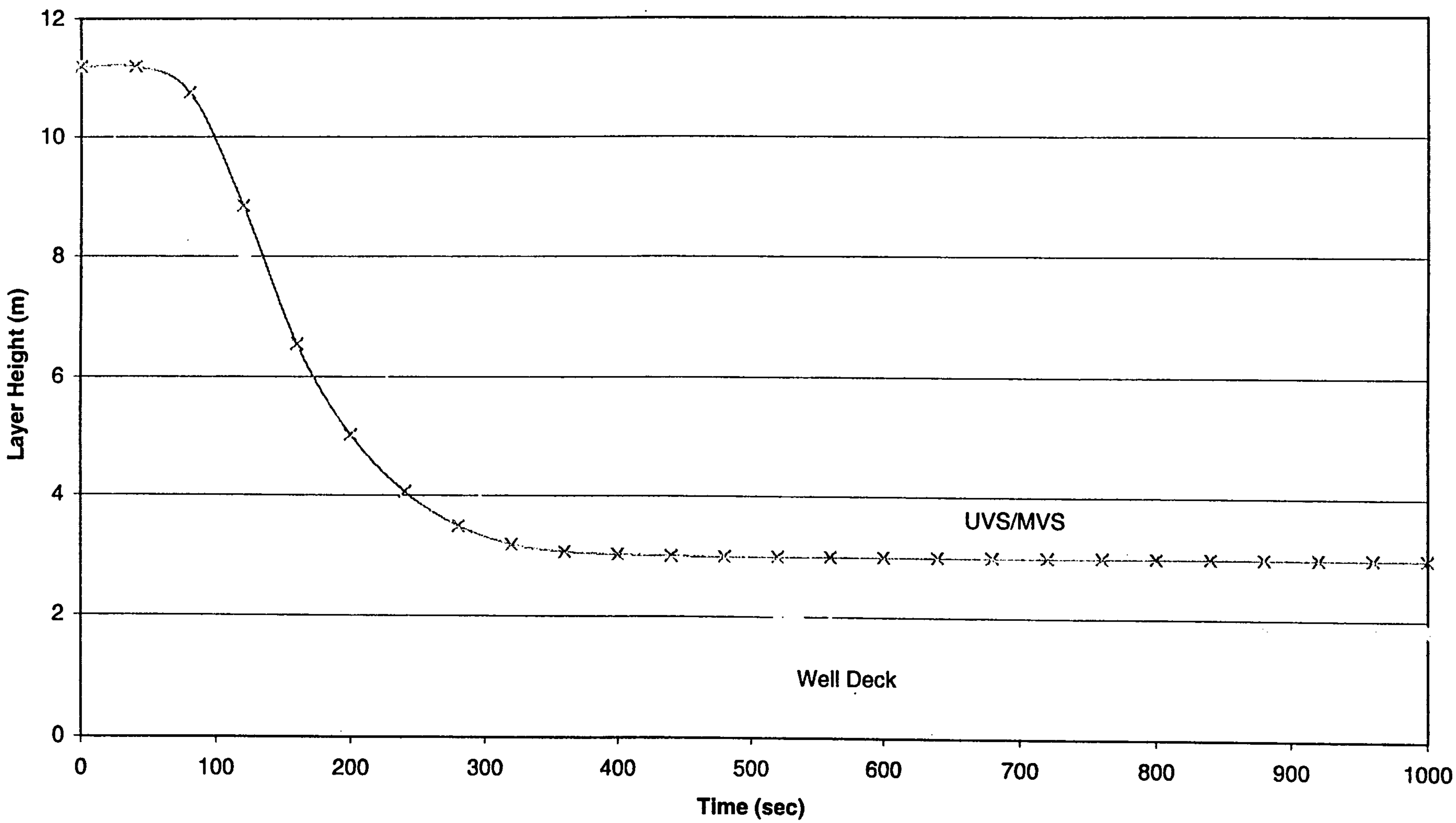
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	32.4	25	9.33	11.2	20.4	20.5	2000	0	0	0
80	37.8	27.7	8.2	10.76	20.3	20.4	4000	0	0	0
120	45	28	8.04	8.84	20.2	20.4	6000	0	0	0
160	49.1	28.4	7.49	6.54	20.1	20.4	8000	0	0	0
200	51.3	29.2	6.72	5.02	20.1	20.3	10000	0	0	0
240	53.8	30.3	5.61	4.06	20.1	20.3	12000	0	0	0
280	57.2	31.6	4.4	3.49	20	20.3	14000	0	0	0
320	60.8	33.1	3.53	3.19	20	20.3	15000	0	0	0
360	62.4	34.5	3.03	3.07	20	20.3	15000	0	0	0
400	63.4	35.4	2.66	3.03	19.9	20.3	15000	0	0	0
440	64.1	36	2.37	3.01	19.9	20.3	15000	0	0	0
480	64.6	36.5	2.17	3	19.9	20.2	15000	0	0	0
520	65.1	36.8	2.03	3	19.9	20.2	15000	0	0	0
560	65.5	37.1	1.94	3	19.9	20.2	15000	0	0	0
600	65.8	37.3	1.88	3	19.9	20.2	15000	0	0	0
640	66	37.5	1.84	3	19.9	20.2	15000	0	0	0
680	66.3	37.6	1.82	3	19.9	20.2	15000	0	0	0
720	66.4	37.7	1.81	3	19.9	20.2	15000	0	0	0
760	66.6	37.8	1.81	3	19.9	20.2	14990	0	0	0
800	66.7	37.9	1.81	3	19.9	20.2	14990	0	0	0
840	66.9	37.9	1.81	3	19.9	20.2	14990	0	0	0
880	67	38	1.82	3	19.9	20.2	14990	0	0	0
920	67.1	38	1.83	3	19.9	20.2	14990	0	0	0
960	67.2	38.1	1.83	3	19.9	20.2	14990	0	0	0
1000	67.3	38.1	1.84	3	19.9	20.2	14990	0	0	0

```
VERSN    3   Scenario 7
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.2  6.8
MVOPN  2  1 V   8.2  4.0
MVOPN  3  4 V  8.2  4.0
MVOPN  1  5 V  11.2  4.0
MVOPN  3  8 V  11.2  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2  0.0  1000. 90
MVFAN  7  6   0.0  1000. 90
INELV    1   11.2  2   11.2  3  11.2  4   11.2
INELV    5   11.2  6   11.2  7  11.2  8   11.2
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO       .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR 1pd17iii.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.    10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.    10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

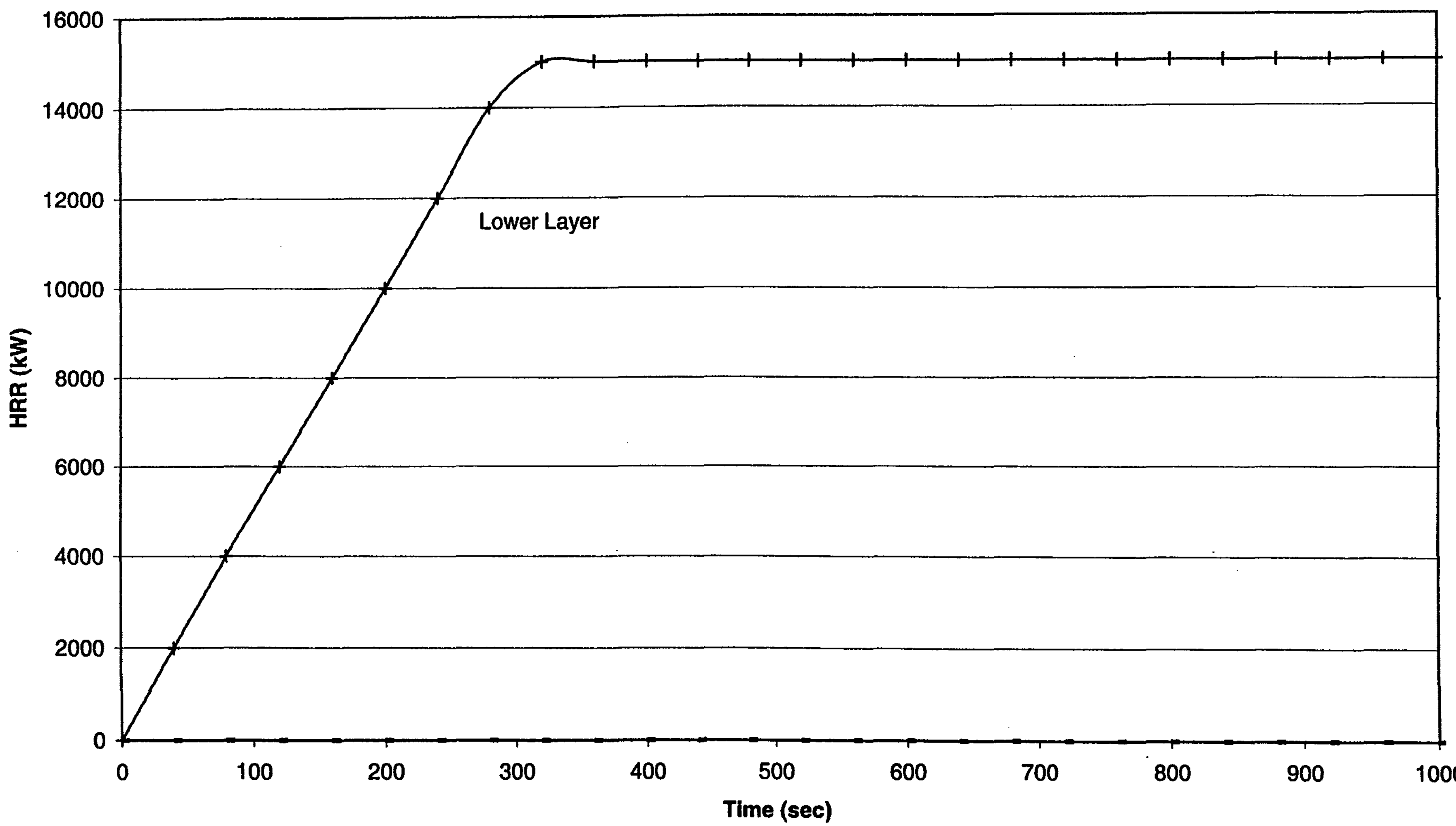


Upper Layer Temperature
Well Deck fire
LCAC supply, no VSA mechanical ventilation, top stern gate open
Well Deck
UVS/MVS
Temp (deg C)
0
50
100
150
200
250
Time (sec)
0
100
200
300
400
500
600
700
800
900
1000

Layer Height
Well Deck fire
LCAC supply, no VSA mechanical ventilation, top stern gate open



HRR, Well Deck
Well Deck fire
LCAC supply, no VSA mechanical ventilation, stern gate open



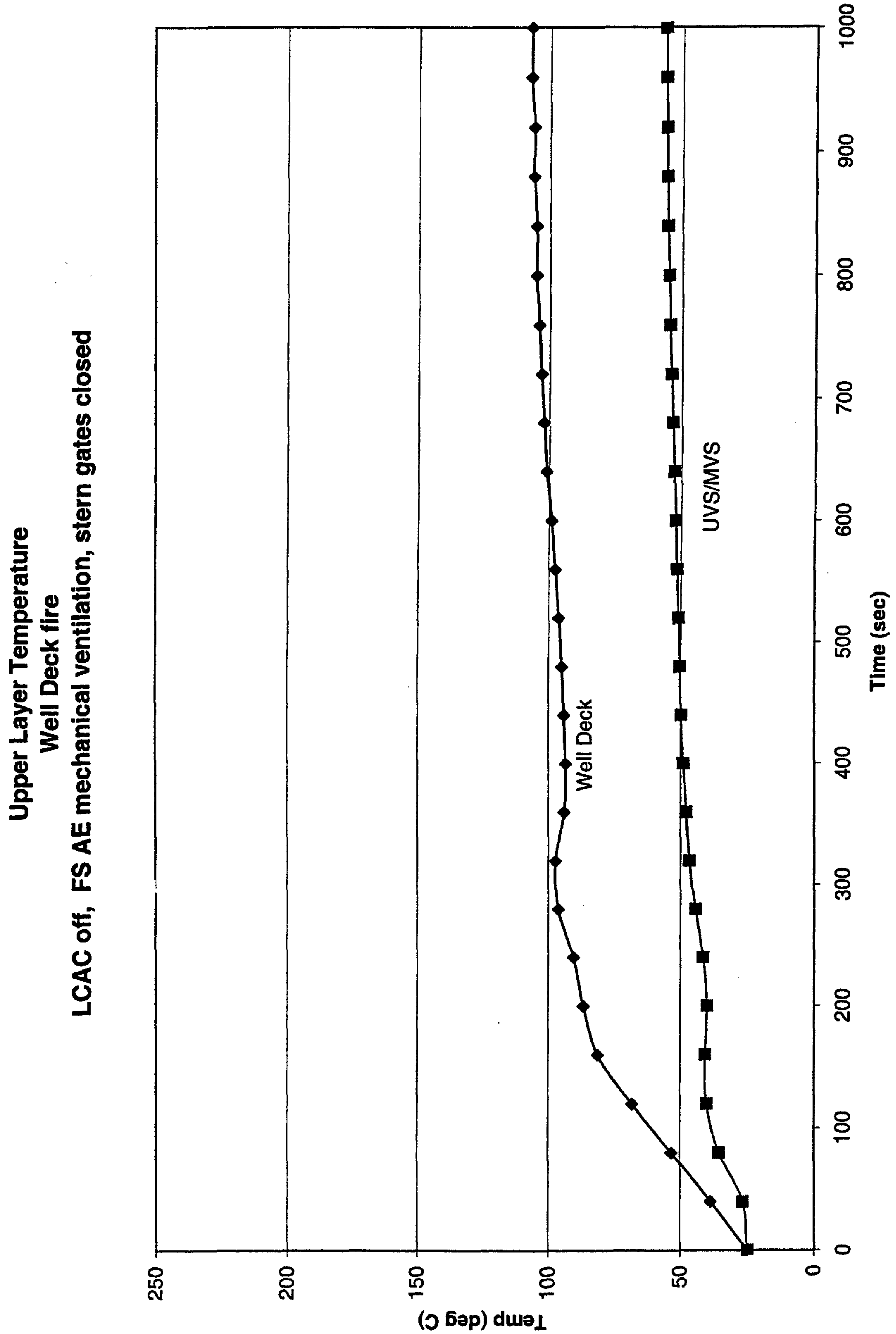
File: lpd17y.in
TSG: closed
BSG: closed
Fire Location: well deck

LCAC: off
Fans: FS, AE
Opening: 2.8 x 5.0

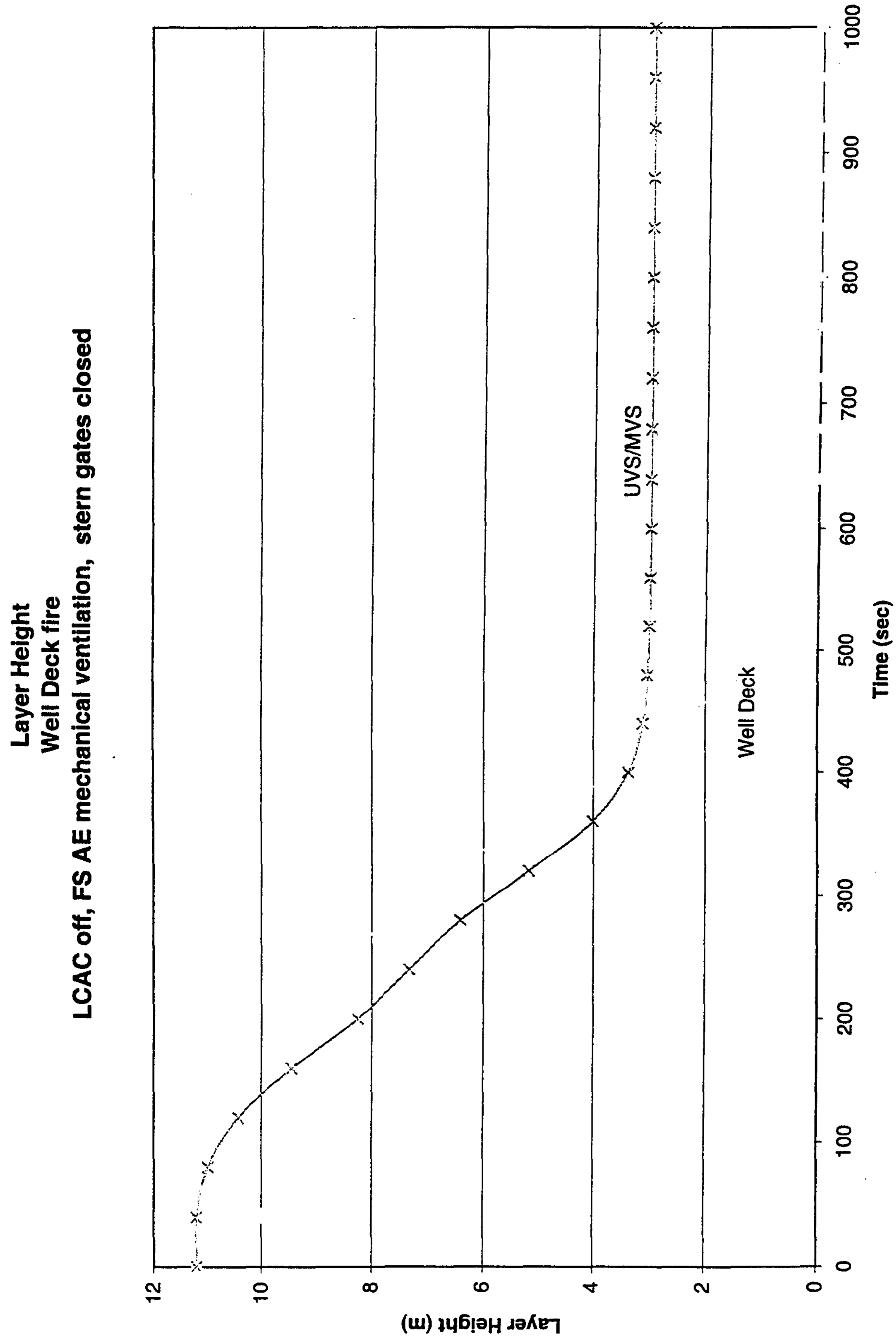
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	38.7	26.6	10.1	11.2	20.4	20.6	2000	0	1.492E-13	0
80	53.2	35.5	9.74	10.99	20.2	20.4	4000	0	2.984E-13	0
120	68.1	40.2	9.63	10.43	20	20.3	6000	0	5.967E-13	0
160	81.3	40.8	9.48	9.44	19.8	20.2	8000	0	5.967E-13	0
200	86.7	40.1	9.08	8.25	19.7	20.2	10000	0	1.193E-12	0
240	90.5	41.6	8.51	7.32	19.6	20.2	12000	0	1.193E-12	0
280	96.2	44.5	7.77	6.41	19.5	20.1	14000	0	1.193E-12	0
320	97.3	46.8	6.64	5.18	19.5	20.1	15000	0	1.193E-12	0
360	94	48	5.06	4.01	19.5	20.1	15000	0	1.193E-12	0
400	93.6	49.1	3.59	3.372	19.5	20.1	15000	0	1.193E-12	0
440	94.2	49.9	2.44	3.116	19.5	20.1	15000	0	1.193E-12	0
480	95	50.4	1.53	3.03584	19.5	20	15000	0	1.193E-12	0
520	96.2	50.9	0.89	3.01099	19.5	20	15000	0	1.193E-12	0
560	97.6	51.5	0.469	3.003349	19.4	20	15000	0	1.193E-12	0
600	99.1	52.1	0.21	3.001013	19.4	20	14990	0	1.193E-12	0
640	101	52.8	0.08045	3.0006757	19.4	20	9358	0	5634	0
680	102	53.4	0.03974	3.0006757	19.4	20	4948	0	10040	0
720	103	54	0.02546	3.0006757	19.3	20	2868	0	12120	0
760	104	54.6	0.01981	3.0006757	19.3	20	1803	0	13190	0
800	105	55	0.01742	3.0006757	19.3	20	1218	0	13770	0
840	105	55.4	0.01643	3.0006757	19.3	19.9	874	0	14110	0
880	106	55.7	0.01612	3.0006757	19.3	19.9	658	0	14330	0
920	106	56	0.01619	3.0006757	19.3	19.9	513	0	14470	0
960	107	56.2	0.01648	3.0006757	19.3	19.9	412	0	14570	0
1000	107	56.4	0.0169	3.0006757	19.3	19.9	337	0	14650	0

```
VERSN   Scenario 8
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  1  9 V   10.0  4.0
MVOPN  3  12 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  10  11   0.0  1000. 75.0
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   10.0  10   10.0  11  10.0  12   10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17y.hi
DEVICE 1
WINDOW        0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
```

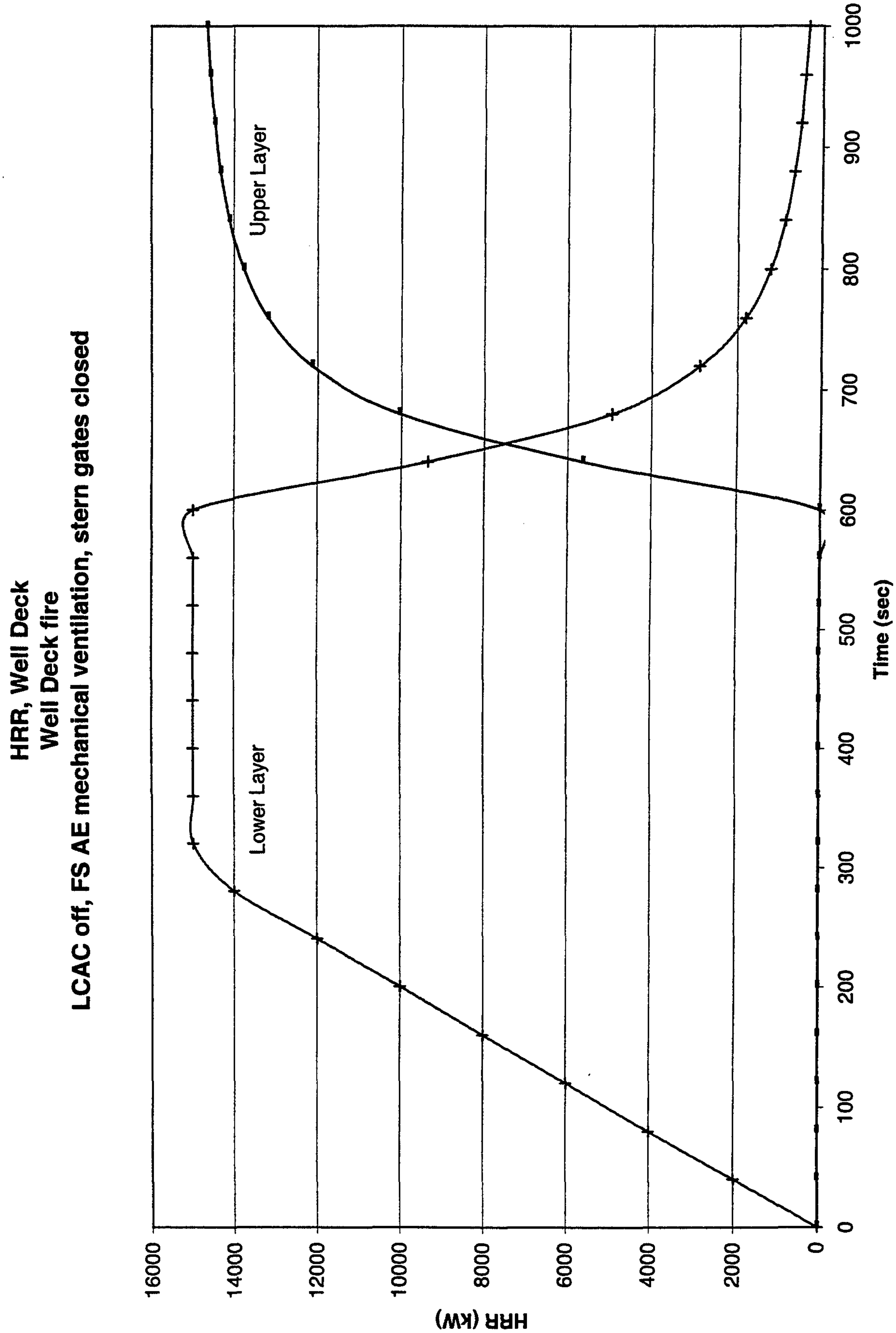
```
GRAPH    2  740.  300.     0.  1220. 920.    10. 5 TIME  CELSIUS
INTER    0  0  0  0 1    1 U
TEMPERA  0  0  0  0 2    1 U
TEMPERA  0  0  0  0 2    1 L
TEMPERA  0  0  0  0 2    2 L
```



Upper Layer Temperature
Well Deck fire
LCAC off, FS AE mechanical ventilation, stern gates closed
Well Deck
UVS/MVS
Temp (deg C)
Time (sec)
0
50
100
150
200
250
0
100
200
300
400
500
600
700
800
900
1000



Layer Height
Well Deck fire
LCAC off, FS AE mechanical ventilation, stern gates closed
Layer Height (m)
Time (sec)
UVS/MVS
Well Deck
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000


HRR, Well Deck
Well Deck fire
LCAC off, FS AE mechanical ventilation, stern gates closed
Upper Layer
Lower Layer
HRR (kW)
Time (sec)
16000
14000
12000
10000
8000
6000
4000
2000
0
100
200
300
400
500
600
700
800
900
1000

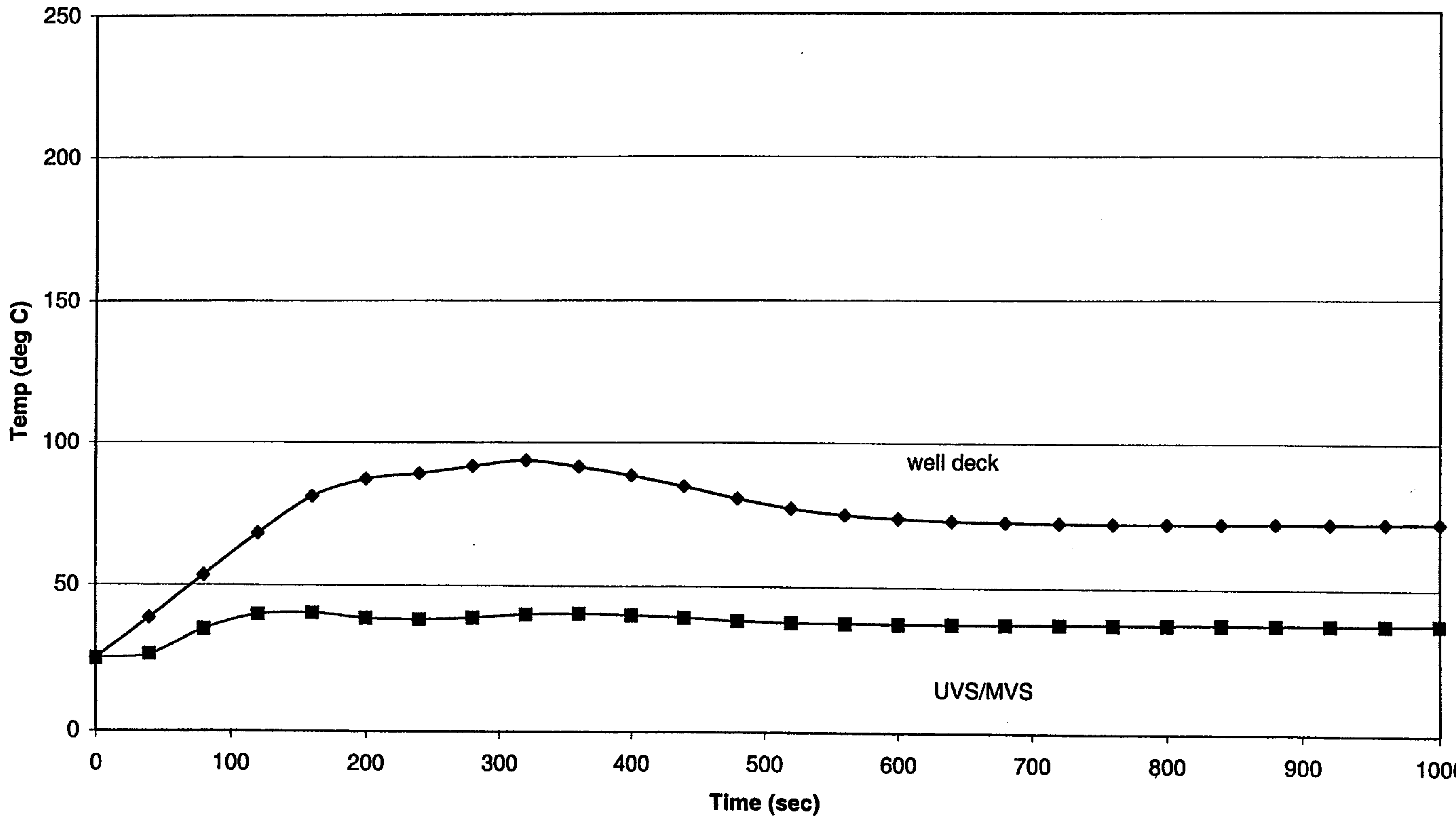
File:	lpd17bb.in		
TSG:	open	**LCAC:**	off
BSG:	closed	**Fans:**	FS, AE
Fire Location:	well deck	**Opening:**	2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.00E+00	25	25	11.2	11.2	20.6	20.6	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	38.8	26.3	10.2	11.2	20.4	20.7	2.00E+03	0.00E+00	1.49E-13	0.00E+00
80	53.5	35	9.93	11.03	20.2	20.4	4.00E+03	0.00E+00	2.98E-13	0.00E+00
120	67.9	40	9.89	10.63	20	20.3	6.00E+03	0.00E+00	5.97E-13	0.00E+00
160	80.8	40.7	9.83	9.91	19.8	20.2	8.00E+03	0.00E+00	5.97E-13	0.00E+00
200	87.1	38.9	9.62	8.93	19.7	20.2	1.00E+04	0.00E+00	1.19E-12	0.00E+00
240	89.1	38.4	9.35	8.03	19.7	20.2	1.20E+04	0.00E+00	1.19E-12	0.00E+00
280	91.7	39.1	9.13	7.39	19.6	20.2	1.40E+04	0.00E+00	1.19E-12	0.00E+00
320	93.7	40.3	8.97	6.94	19.6	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
360	91.5	40.6	8.8	6.53	19.7	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
400	88.4	40.1	8.58	6.02	19.7	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
440	84.6	39.3	8.31	5.39	19.8	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
480	80.3	38.3	7.97	4.65	19.8	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
520	76.9	37.8	7.62	4.09	19.9	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
560	74.8	37.6	7.35	3.707	19.9	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
600	73.6	37.5	7.15	3.449	19.9	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
640	72.8	37.5	7.02	3.282	19.9	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
680	72.4	37.5	6.93	3.175	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
720	72.2	37.6	6.88	3.108	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
760	72.1	37.6	6.85	3.06614	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
800	72.1	37.6	6.83	3.04039	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
840	72.1	37.7	6.82	3.02458	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
880	72.2	37.7	6.82	3.01493	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
920	72.2	37.8	6.81	3.009044	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
960	72.3	37.8	6.81	3.005471	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
1.00E+03	72.4	37.9	6.82	3.003304	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00

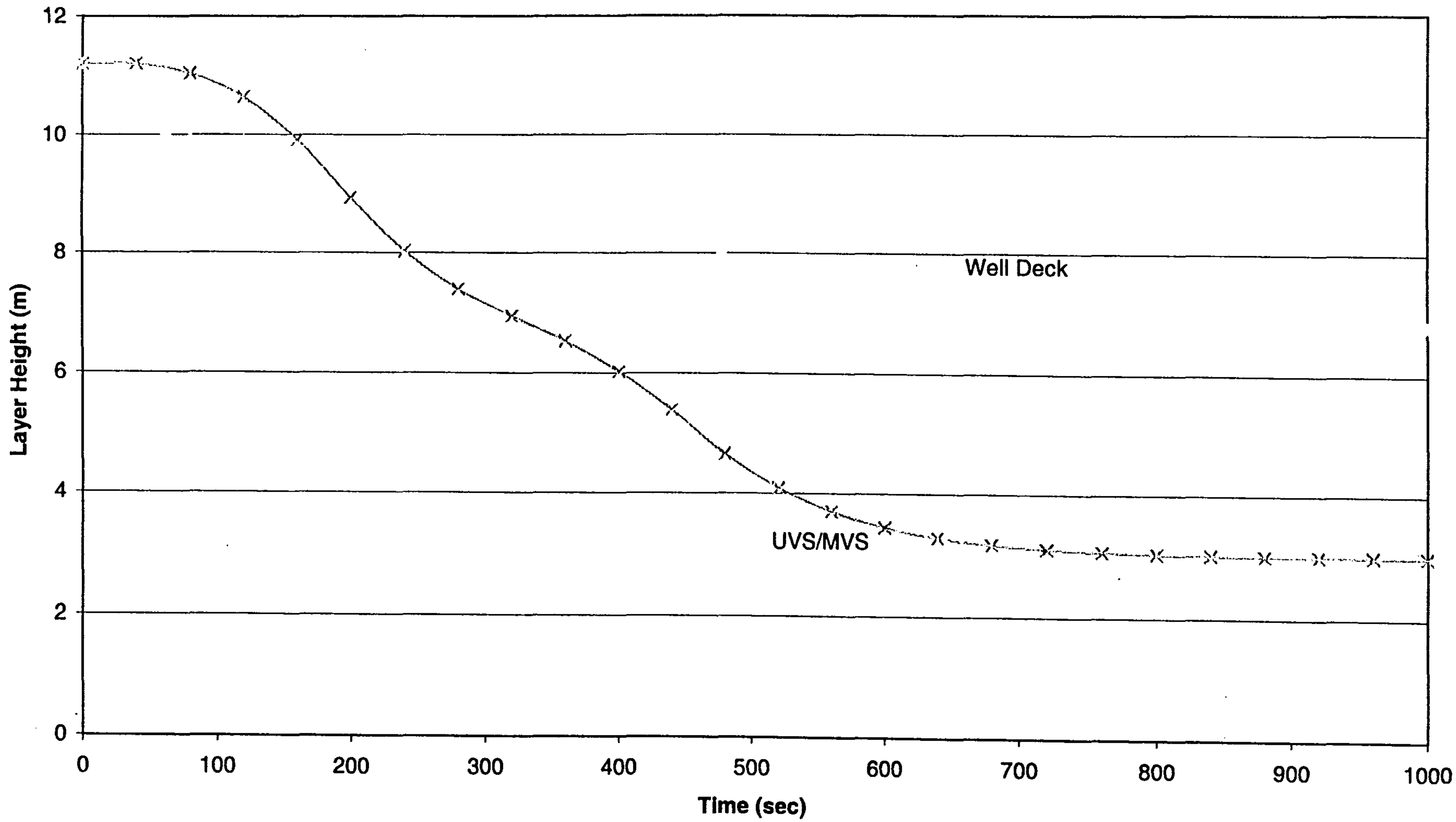
```
VERSN    3  Scenario 9
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8 5.0  0.0
HVENT  1  3  2   18.5 11.0 6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  1  9 V   10.0  4.0
MVOPN  3  12 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  10  11   0.0  1000. 75.0
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   10.0  10   10.0  11  10.0  12   10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 16. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17bb.hi
DEVICE 1
WINDOW       0      0  -100  1280  1024   1100
```

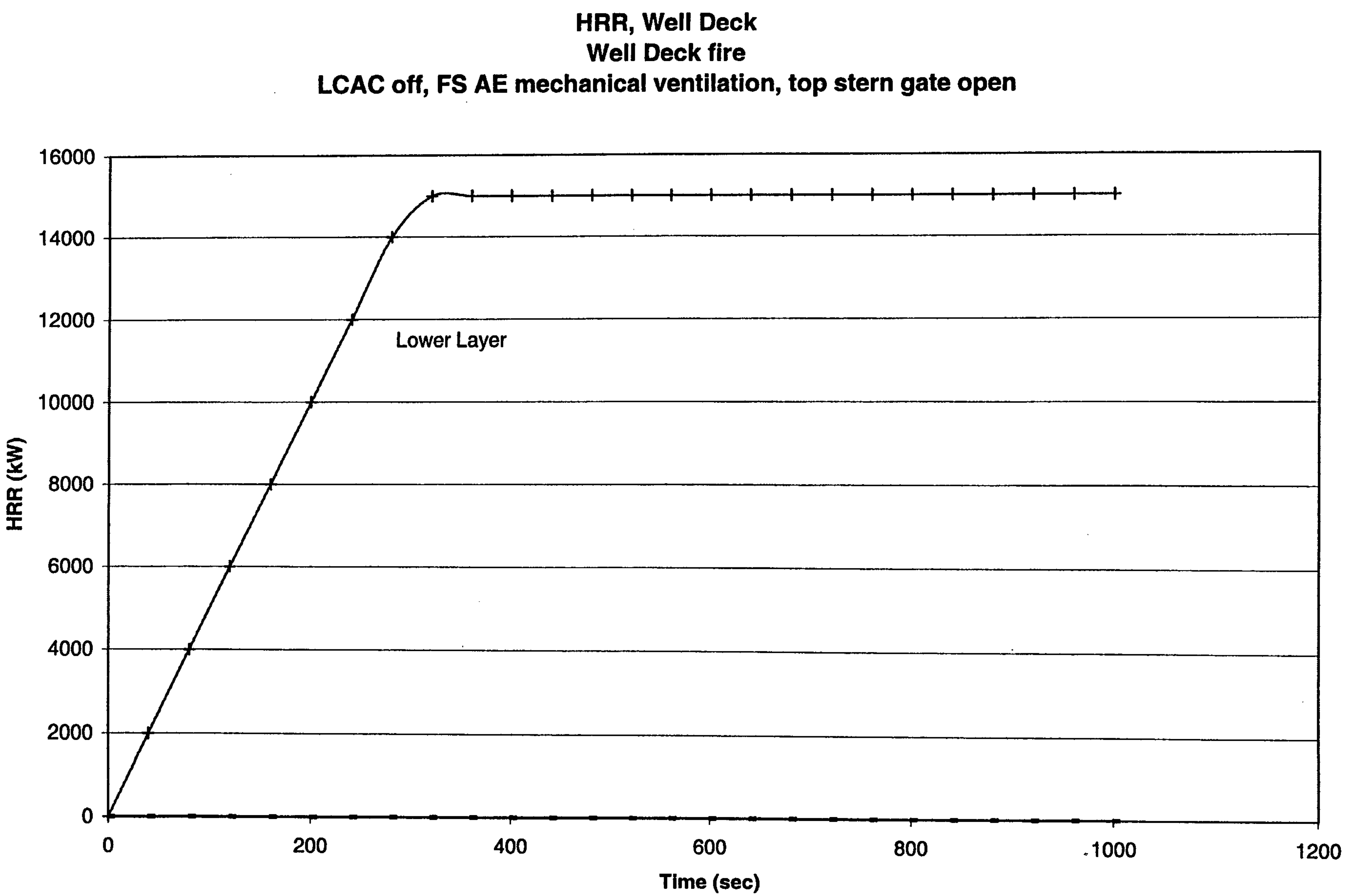
```
GRAPH    1  120.   300.     0.  600.  920.    10. 5 TIME   METERS
GRAPH    2  740.   300.     0.  1220. 920.    10. 5 TIME   CELSIUS
INTER    0 0 0 0 1    1 U
TEMPERA  0 0 0 0 2    1 U
TEMPERA  0 0 0 0 2    1 L
TEMPERA  0 0 0 0 2    2 L
```

Upper Layer Temperature
Well Deck fire
LCAC off, FS AE mechanical ventilation, top stern gate open



Layer Height
Well Deck fire
LCAC off, FS AE mechanical ventilation, top stern gate open




HRR, Well Deck
Well Deck fire
LCAC off, FS AE mechanical ventilation, top stern gate open
16000
14000
12000
10000
8000
6000
4000
2000
0
HRR (kW)
Lower Layer
0
200
400
600
800
1000
1200
Time (sec)

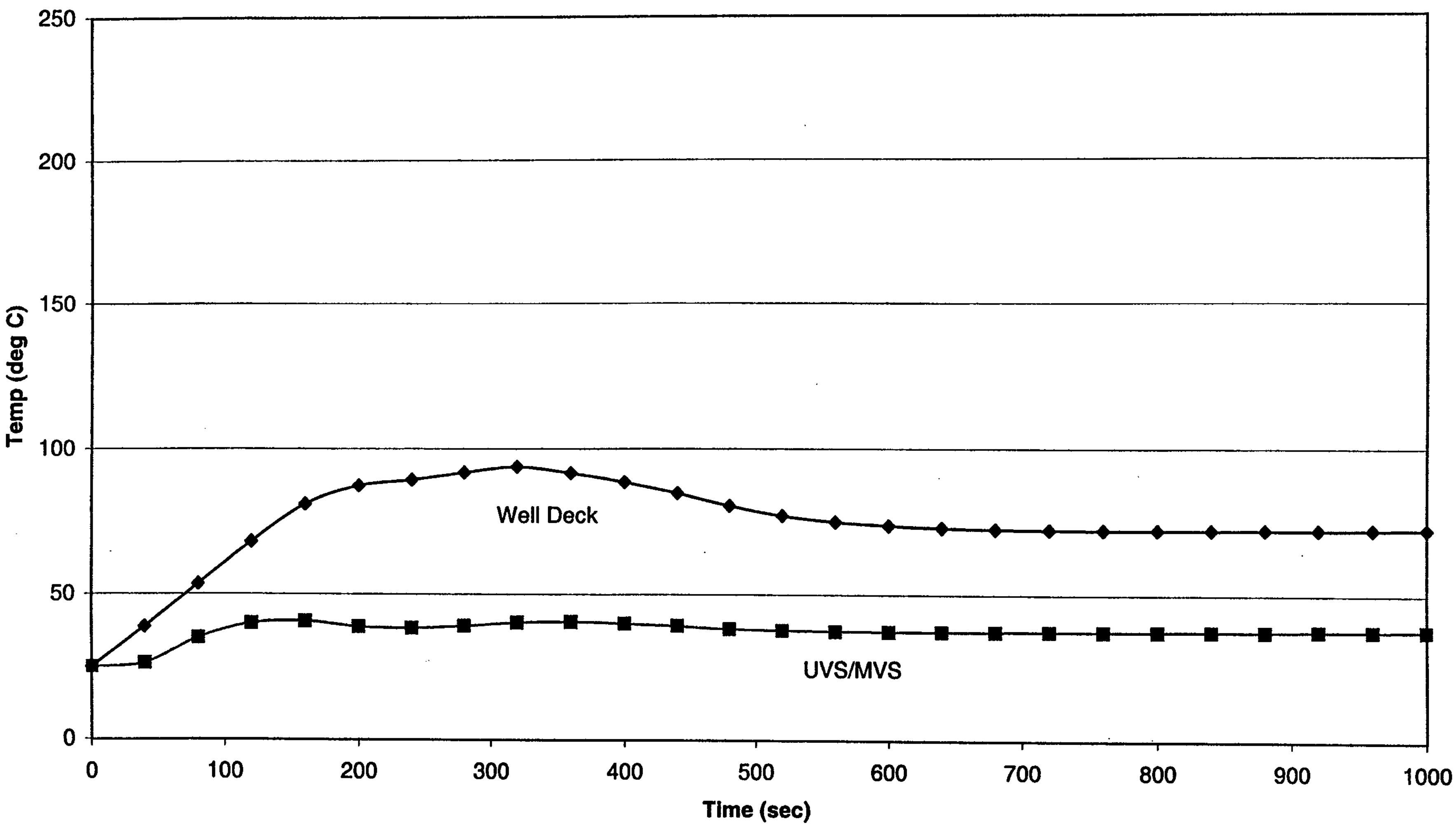
File:	lpd17ee.in		
TSG:	open	**LCAC:**	off
BSG:	open	**Fans:**	FS, AE
Fire Location:	well deck	**Opening:**	2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.00E+00	25	25	11.2	11.2	20.6	20.6	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	38.8	26.3	10.2	11.2	20.4	20.7	2.00E+03	0.00E+00	1.49E-13	0.00E+00
80	53.5	35	9.93	11.03	20.2	20.4	4.00E+03	0.00E+00	2.98E-13	0.00E+00
120	67.9	40	9.89	10.63	20	20.3	6.00E+03	0.00E+00	5.97E-13	0.00E+00
160	80.8	40.7	9.83	9.91	19.8	20.2	8.00E+03	0.00E+00	5.97E-13	0.00E+00
200	87.1	38.9	9.62	8.93	19.7	20.2	1.00E+04	0.00E+00	1.19E-12	0.00E+00
240	89.1	38.4	9.35	8.03	19.7	20.2	1.20E+04	0.00E+00	1.19E-12	0.00E+00
280	91.7	39.1	9.13	7.39	19.6	20.2	1.40E+04	0.00E+00	1.19E-12	0.00E+00
320	93.7	40.3	8.97	6.94	19.6	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
360	91.5	40.6	8.8	6.53	19.7	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
400	88.4	40.1	8.58	6.02	19.7	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
440	84.6	39.3	8.31	5.39	19.8	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
480	80.3	38.3	7.97	4.65	19.8	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
520	76.9	37.8	7.62	4.09	19.9	20.2	1.50E+04	0.00E+00	1.19E-12	0.00E+00
560	74.8	37.6	7.35	3.707	19.9	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
600	73.6	37.5	7.15	3.449	19.9	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
640	72.8	37.5	7.02	3.282	19.9	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
680	72.4	37.5	6.93	3.175	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
720	72.2	37.6	6.88	3.108	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
760	72.1	37.6	6.85	3.06614	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
800	72.1	37.6	6.83	3.04039	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
840	72.1	37.7	6.82	3.02458	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
880	72.2	37.7	6.82	3.01493	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
920	72.2	37.8	6.81	3.009044	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
960	72.3	37.8	6.81	3.005471	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00
1.00E+03	72.4	37.9	6.82	3.003304	20	20.3	1.50E+04	0.00E+00	1.19E-12	0.00E+00

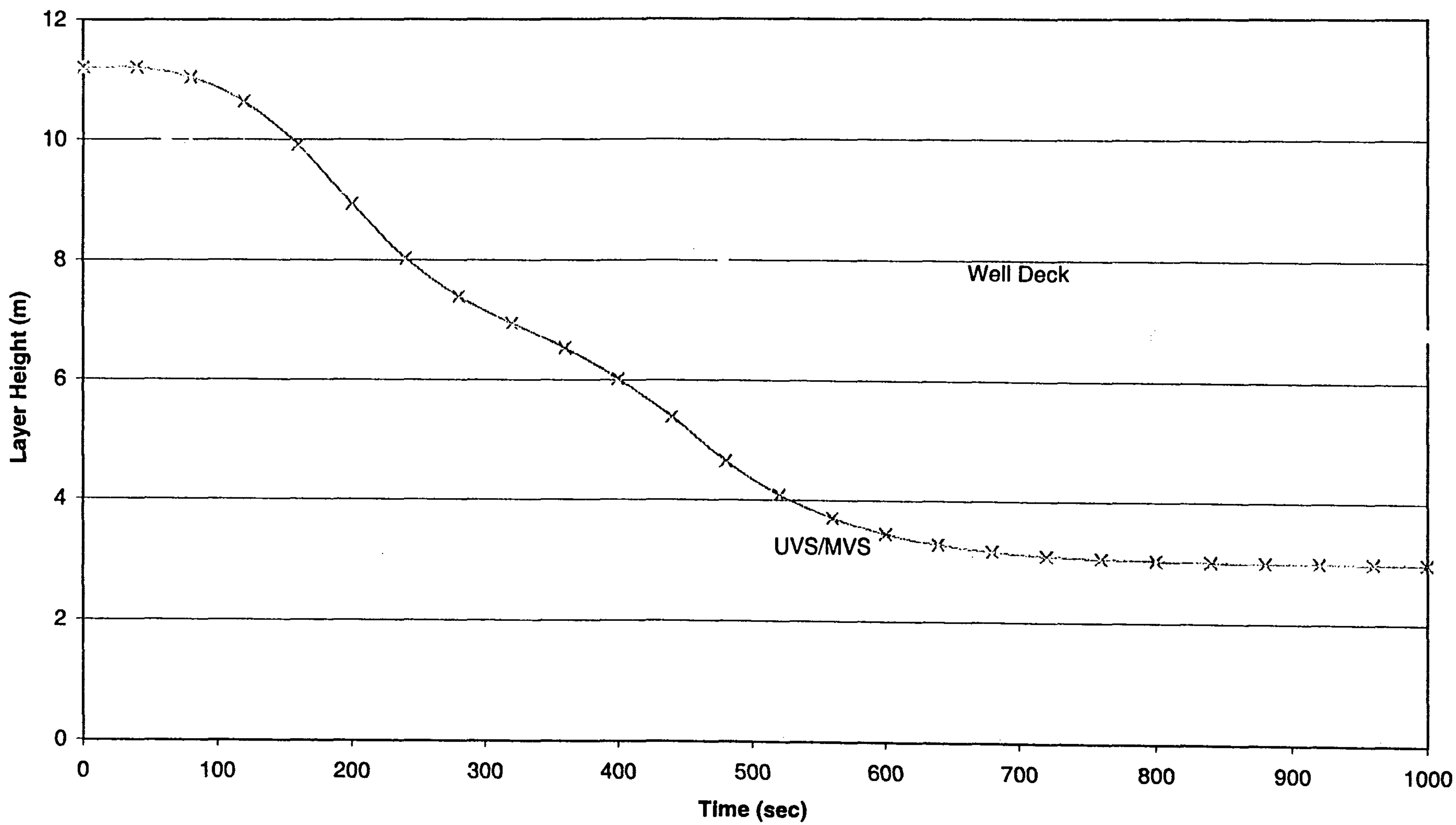
```
VERSN    3  Scenario 10
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  1  9 V   10.0  4.0
MVOPN  3  12 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  10  11   0.0  1000. 75.0
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   10.0  10   10.0  11  10.0  12   10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR 1pd17ee.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
```

```
GRAPH    1  120.  300.     0.  600.  920.    10. 5 TIME  METERS
GRAPH    2  740.  300.     0.  1220. 920.    10. 5 TIME  CELSIUS
INTER    0 0 0 0 1    1 U
TEMPERA 0 0 0 0 2    1 U
TEMPERA 0 0 0 0 2    1 L
TEMPERA 0 0 0 0 2    2 L
```

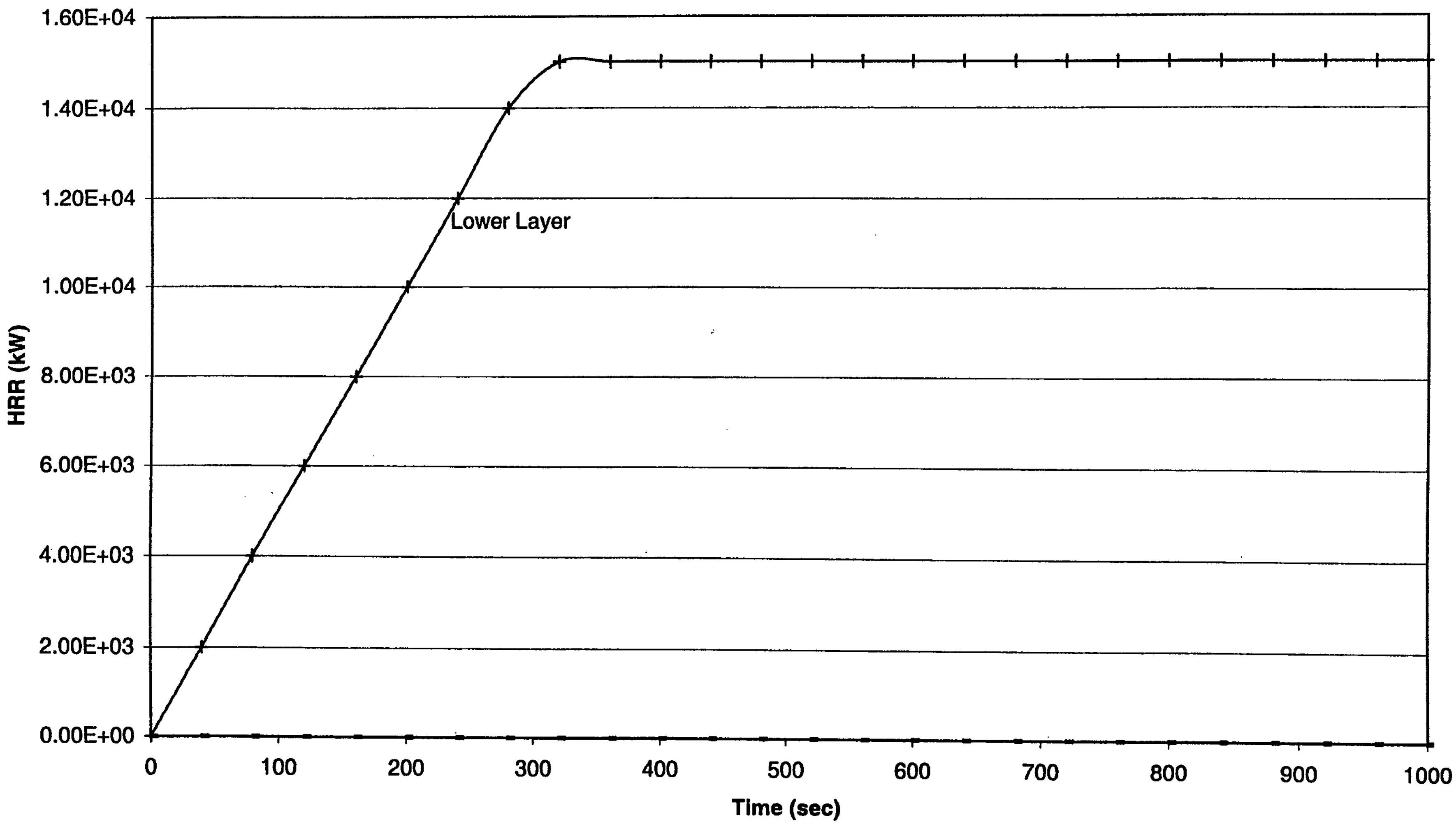
Upper Layer Temperature
Well Deck fire
LCAC off, FS AE mechanical ventilation, stern gates open



Layer Height
Well Deck fire
LCAC off, FS AE mechanical ventilation, stern gates open



HRR, Well Deck
Well Deck fire
LCAC off, FS AE mechanical ventilation, stern gates open



File: lpd17ww.in
TSG: open
BSG: closed
Fire Location: well deck

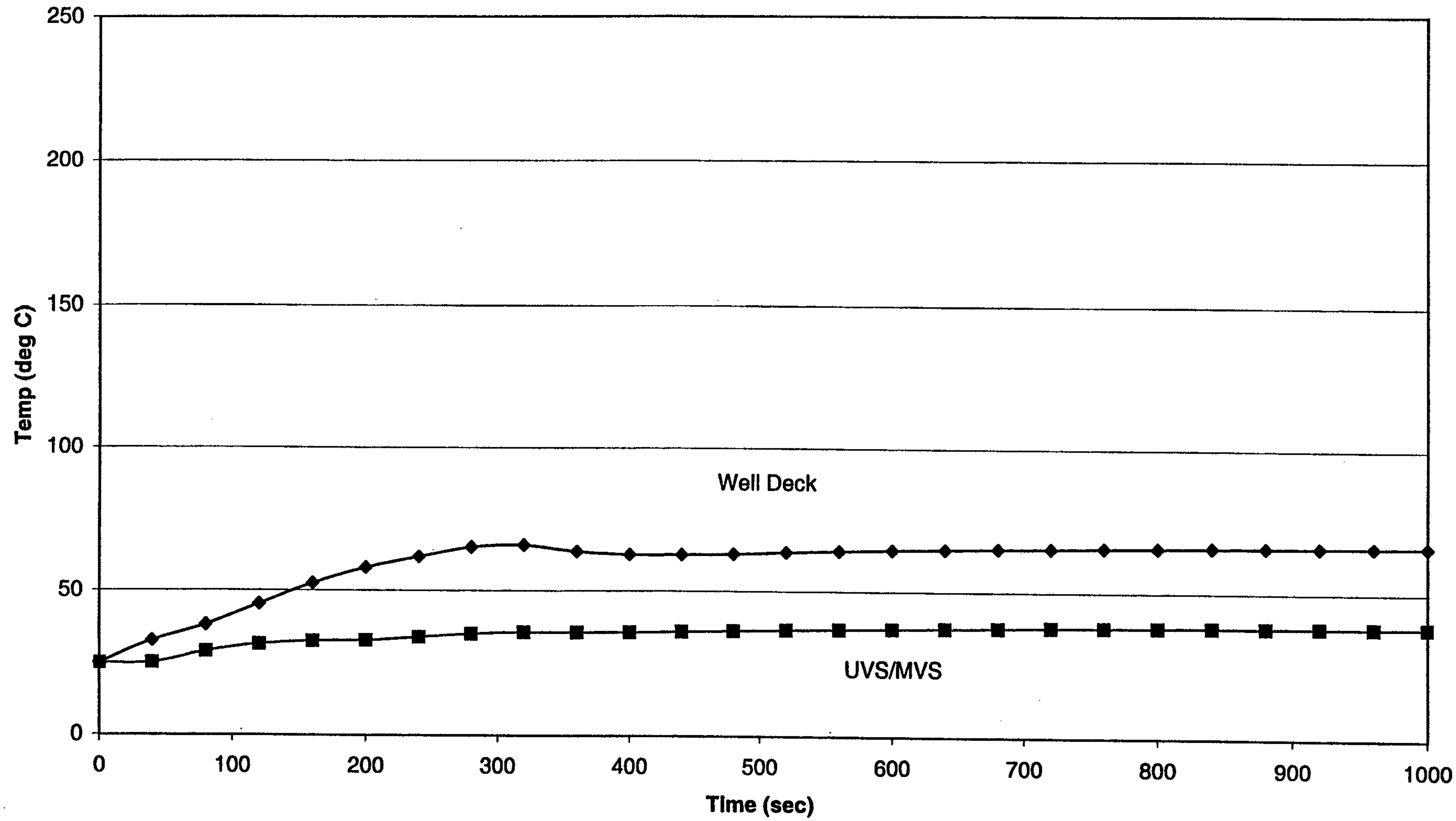
LCAC: supply
Fans: FS,AE
Opening: 2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	32.7	25.1	9.61	11.2	20.4	22.2	2000	0	9.324E-15	0
80	38.1	29	8.86	11.02	20.3	20.4	4000	0	2.984E-13	0
120	45.3	31.5	8.73	10.5	20.2	20.4	6000	0	5.967E-13	0
160	52.6	32.6	8.71	9.52	20.1	20.3	8000	0	5.967E-13	0
200	58.1	32.9	8.47	8.17	20	20.3	10000	0	1.193E-12	0
240	62	34	8.06	7.13	20	20.3	12000	0	1.193E-12	0
280	65.4	35.2	7.63	6.22	19.9	20.3	14000	0	1.193E-12	0
320	66.1	35.7	7.03	5.13	19.9	20.3	15000	0	1.193E-12	0
360	63.9	35.7	6.25	4.18	19.9	20.3	15000	0	1.193E-12	0
400	62.9	35.8	5.41	3.598	20	20.3	15000	0	1.193E-12	0
440	62.9	36.1	4.7	3.28	20	20.3	15000	0	1.193E-12	0
480	63.2	36.4	4.18	3.122	19.9	20.3	15000	0	1.193E-12	0
520	63.8	36.7	3.85	3.05023	19.9	20.2	15000	0	1.193E-12	0
560	64.3	37	3.64	3.02006	19.9	20.2	15000	0	1.193E-12	0
600	64.7	37.3	3.53	3.007851	19.9	20.2	15000	0	1.193E-12	0
640	65	37.5	3.46	3.003036	19.9	20.2	15000	0	1.193E-12	0
680	65.3	37.7	3.43	3.001166	19.9	20.2	15000	0	1.193E-12	0
720	65.5	37.9	3.42	3.0006757	19.9	20.2	15000	0	1.193E-12	0
760	65.7	38	3.42	3.0006757	19.9	20.2	15000	0	1.193E-12	0
800	65.8	38.1	3.42	3.0006757	19.9	20.2	15000	0	1.193E-12	0
840	66	38.2	3.43	3.0006757	19.9	20.2	15000	0	1.193E-12	0
880	66.1	38.2	3.43	3.0006757	19.9	20.2	15000	0	1.193E-12	0
920	66.2	38.3	3.44	3.0006757	19.9	20.2	15000	0	1.193E-12	0
960	66.3	38.3	3.45	3.0006757	19.9	20.2	15000	0	1.193E-12	0
1000	66.4	38.4	3.45	3.0006757	19.9	20.2	15000	0	1.193E-12	0

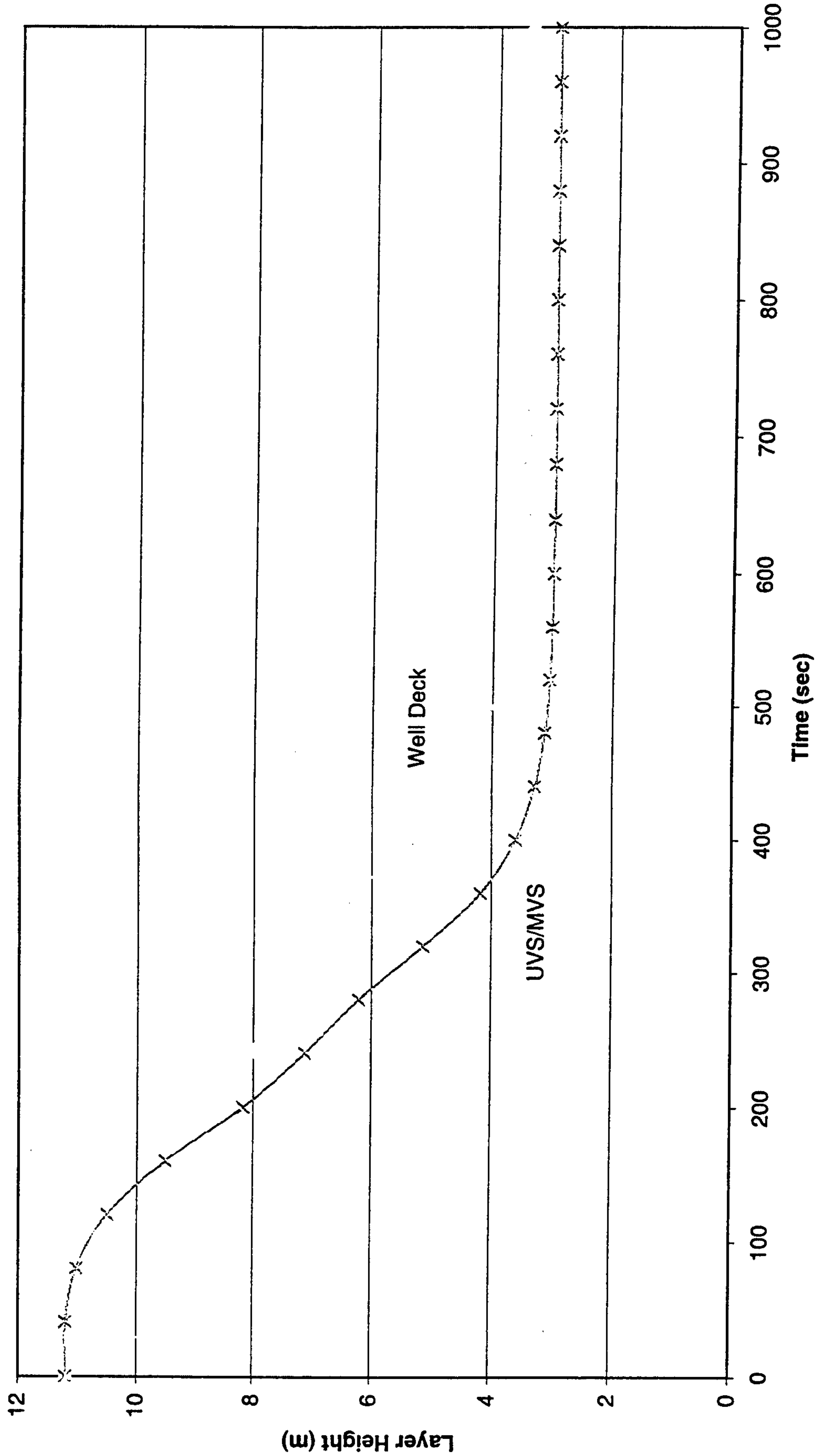
```
VERSN    3  Scenario 11
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.0  6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   9.0  4.0
MVOPN  2  12 V  9.0  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVOPN  1  17 V   10.0  4.0
MVOPN  3  20 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  17 18   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  19 20   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  11 10   0.0  1000. 90
MVFAN  15 14   0.0  1000. 90
MVFAN  18 19   0.0  1000. 75
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   12.0  10   12.0  11  12.0  12   12.0
INELV    13   11.2  14   11.2  15  11.2  16   11.2
INELV    17   10.0   18   10.0  19  10.0   20  10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO     .0072
LFBO  1
LFBT  2
```

```
OD     .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17ww.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

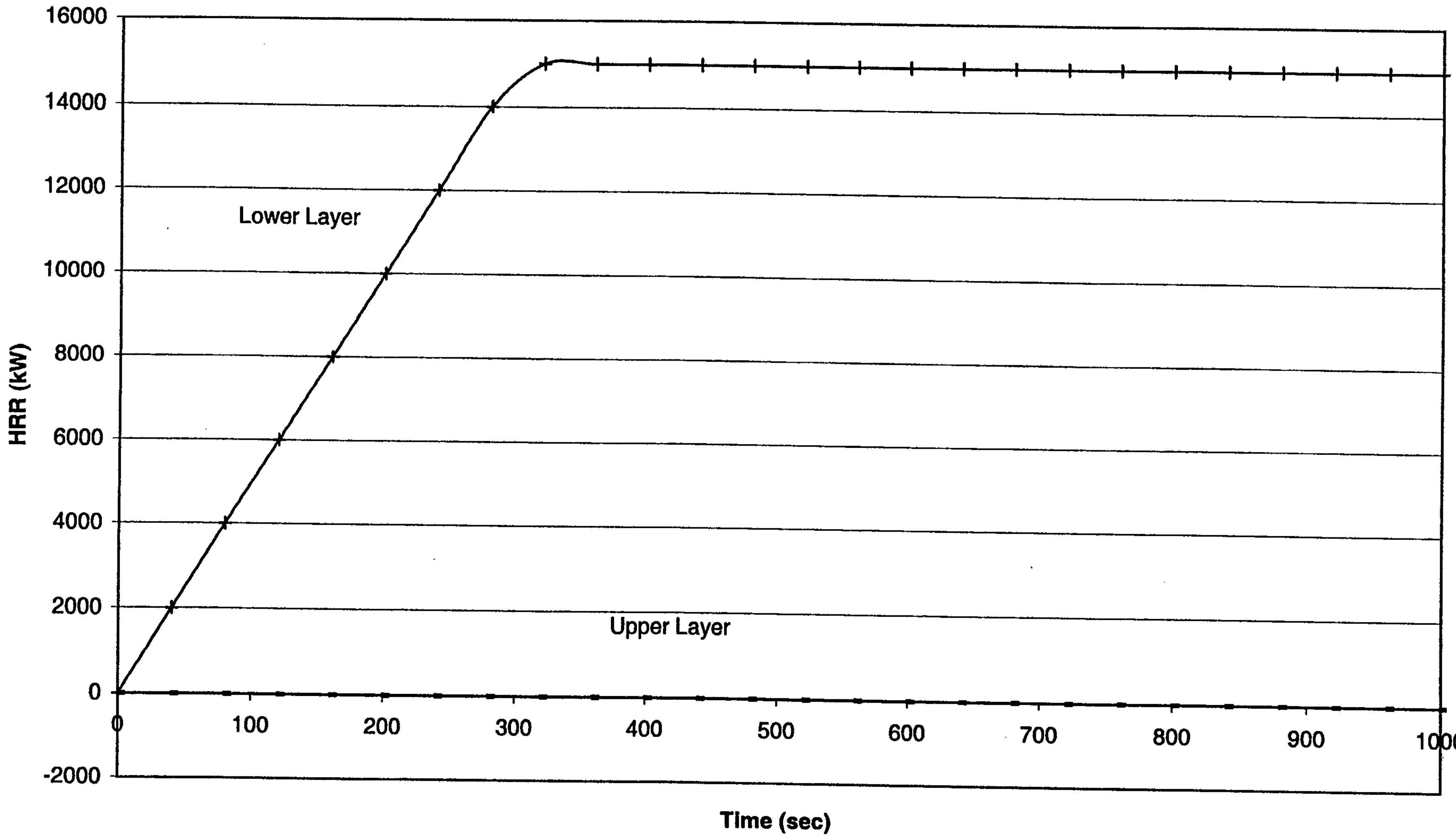
Upper Layer Temperature
Well Deck fire
LCAC supply, FS AE mechanical ventilation, top stern gate open



Layer Height
Well Deck fire
LCAC supply, FS AE mechanical ventilation, top stern gate open



HRR, Well Deck
Well Deck fire
LCAC supply, FS AE mechanical ventilation, top stern gate open



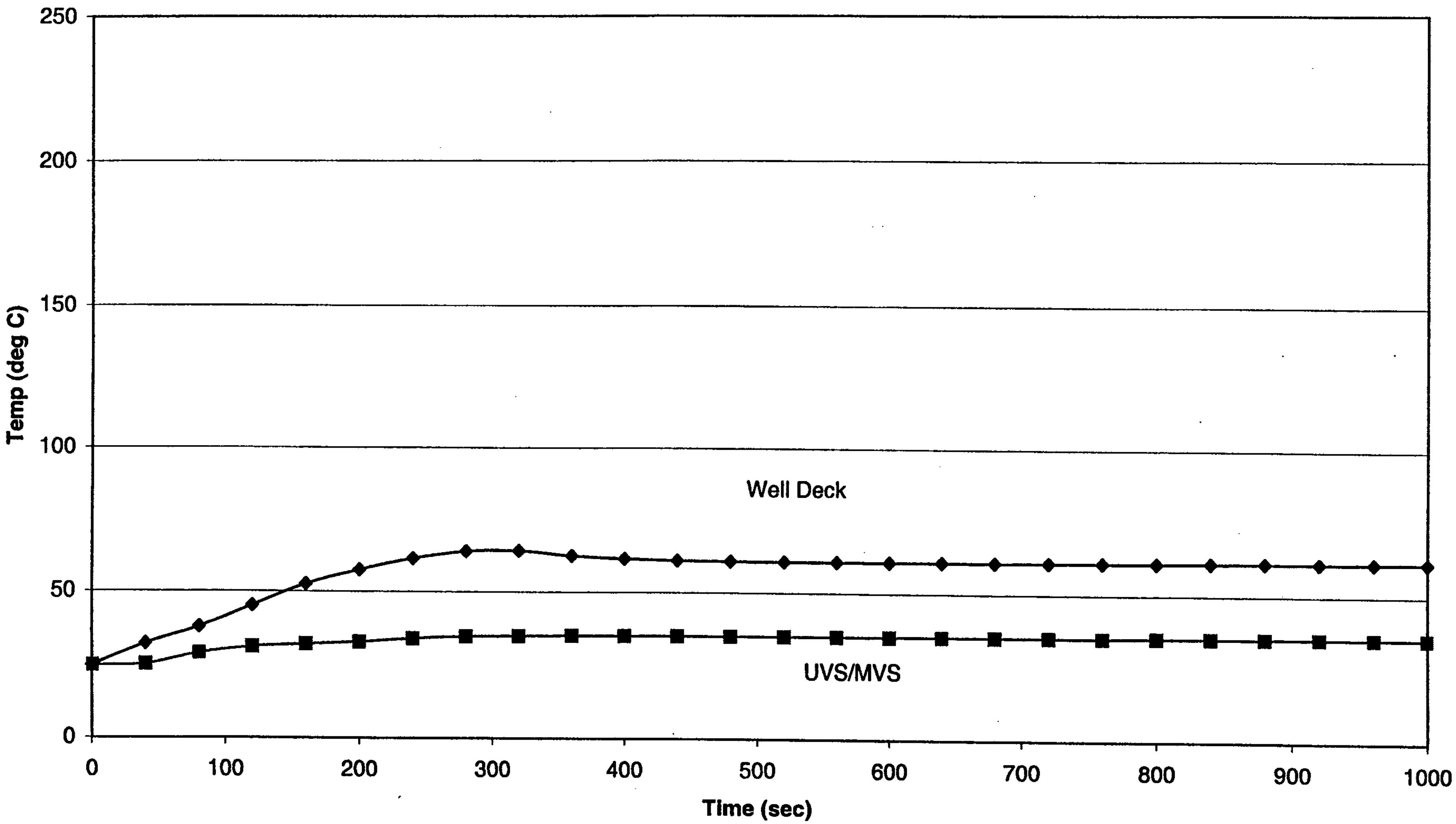
File:	lpd17zz.in		
TSG:	open	**LCAC:**	supply
BSG:	open	**Fans:**	FS,AE
Fire Location:	well deck	**Opening:**	2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	32.3	25.3	9.39	11.2	20.4	21.2	2000	0	7.459E-14	0
80	37.9	29.1	8.42	10.95	20.3	20.4	4000	0	2.984E-13	0
120	45.2	31.3	8.29	10.2	20.2	20.4	6000	0	2.984E-13	0
160	52.6	32.2	8.34	8.9	20.1	20.3	8000	0	2.984E-13	0
200	57.5	33	8.05	7.59	20	20.3	10000	0	2.984E-13	0
240	61.3	34.2	7.66	6.63	20	20.3	12000	0	2.984E-13	0
280	63.9	34.9	7.19	5.6	19.9	20.3	14000	0	2.984E-13	0
320	64.1	35.1	6.55	4.51	19.9	20.3	15000	0	2.984E-13	0
360	62.4	35.3	6.01	3.811	20	20.3	15000	0	2.984E-13	0
400	61.5	35.3	5.66	3.424	20	20.3	15000	0	2.984E-13	0
440	61	35.3	5.45	3.217	20	20.3	15000	0	2.984E-13	0
480	60.8	35.3	5.34	3.11	20	20.3	15000	0	2.984E-13	0
520	60.7	35.3	5.29	3.05504	20	20.3	15000	0	2.984E-13	0
560	60.7	35.3	5.26	3.02746	20	20.3	15000	0	2.984E-13	0
600	60.7	35.3	5.25	3.01365	20	20.3	15000	0	2.984E-13	0
640	60.8	35.4	5.25	3.006771	20	20.3	15000	0	2.984E-13	0
680	60.8	35.4	5.26	3.003352	20	20.3	15000	0	2.984E-13	0
720	60.9	35.4	5.27	3.001657	20	20.3	15000	0	2.984E-13	0
760	61	35.4	5.28	3.0008174	20	20.3	15000	0	2.984E-13	0
800	61	35.5	5.29	3.0006757	20	20.3	15000	0	2.984E-13	0
840	61.1	35.5	5.3	3.0006757	20	20.3	15000	0	2.984E-13	0
880	61.2	35.5	5.31	3.0006757	20	20.3	15000	0	2.984E-13	0
920	61.2	35.6	5.31	3.0006757	20	20.3	15000	0	2.984E-13	0
960	61.3	35.6	5.32	3.0006757	20	20.3	15000	0	2.984E-13	0
1000	61.4	35.6	5.33	3.0006757	20	20.3	15000	0	2.984E-13	0

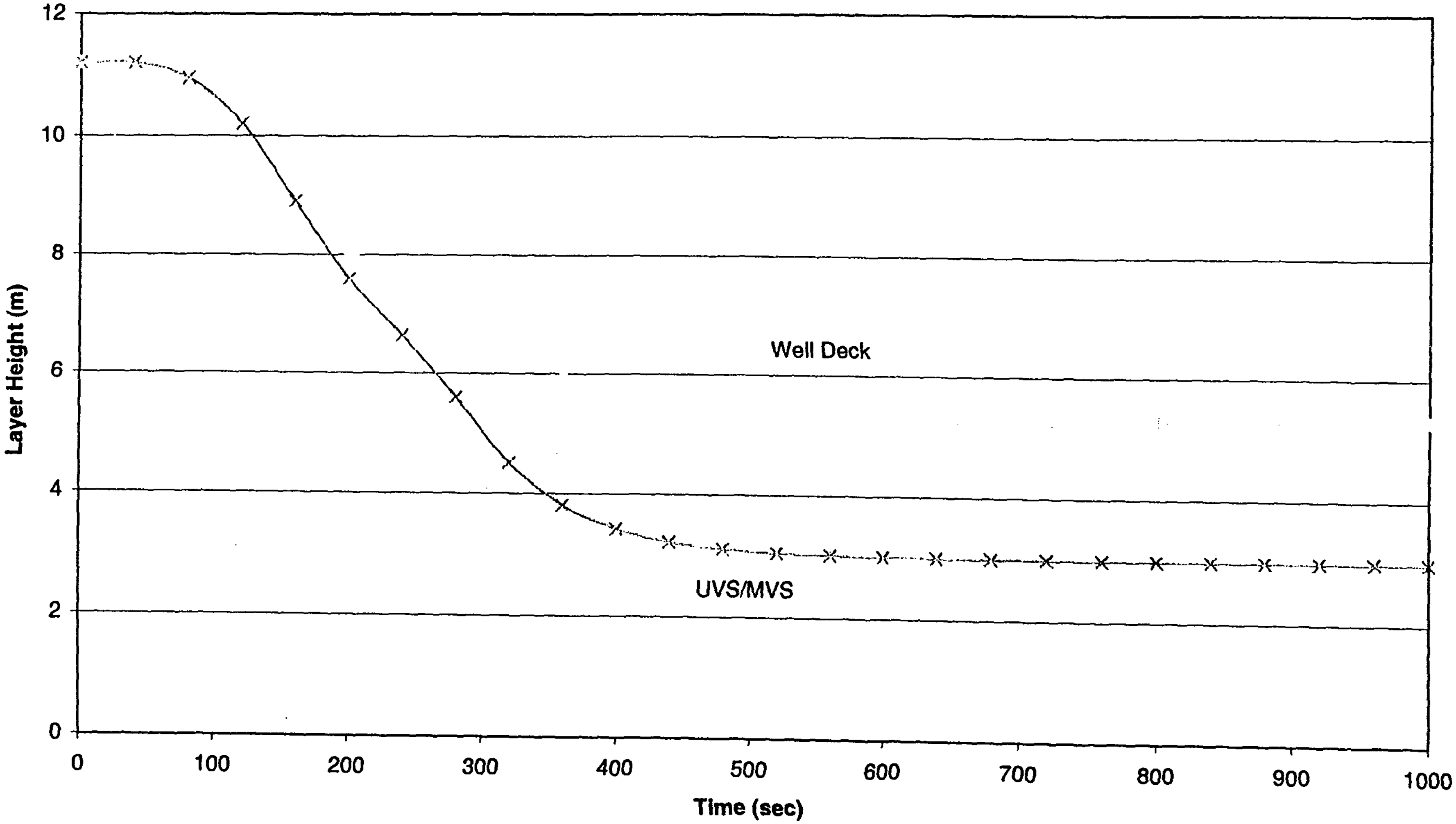
```
VERSN    3  Scenario 12
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.0 0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   9.0  4.0
MVOPN  2  12 V  9.0  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVOPN  1  17 V   10.0  4.0
MVOPN  3  20 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  17 18   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  19 20   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  11 10   0.0  1000. 90
MVFAN  15 14   0.0  1000. 90
MVFAN  18 19   0.0  1000. 75
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   12.0  10   12.0  11  12.0  12   12.0
INELV    13   11.2  14   11.2  15  11.2  16   11.2
INELV    17   10.0   18   10.0  19  10.0   20  10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
```

```
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17zz.hi
DEVICE 1
WINDOW       0      0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

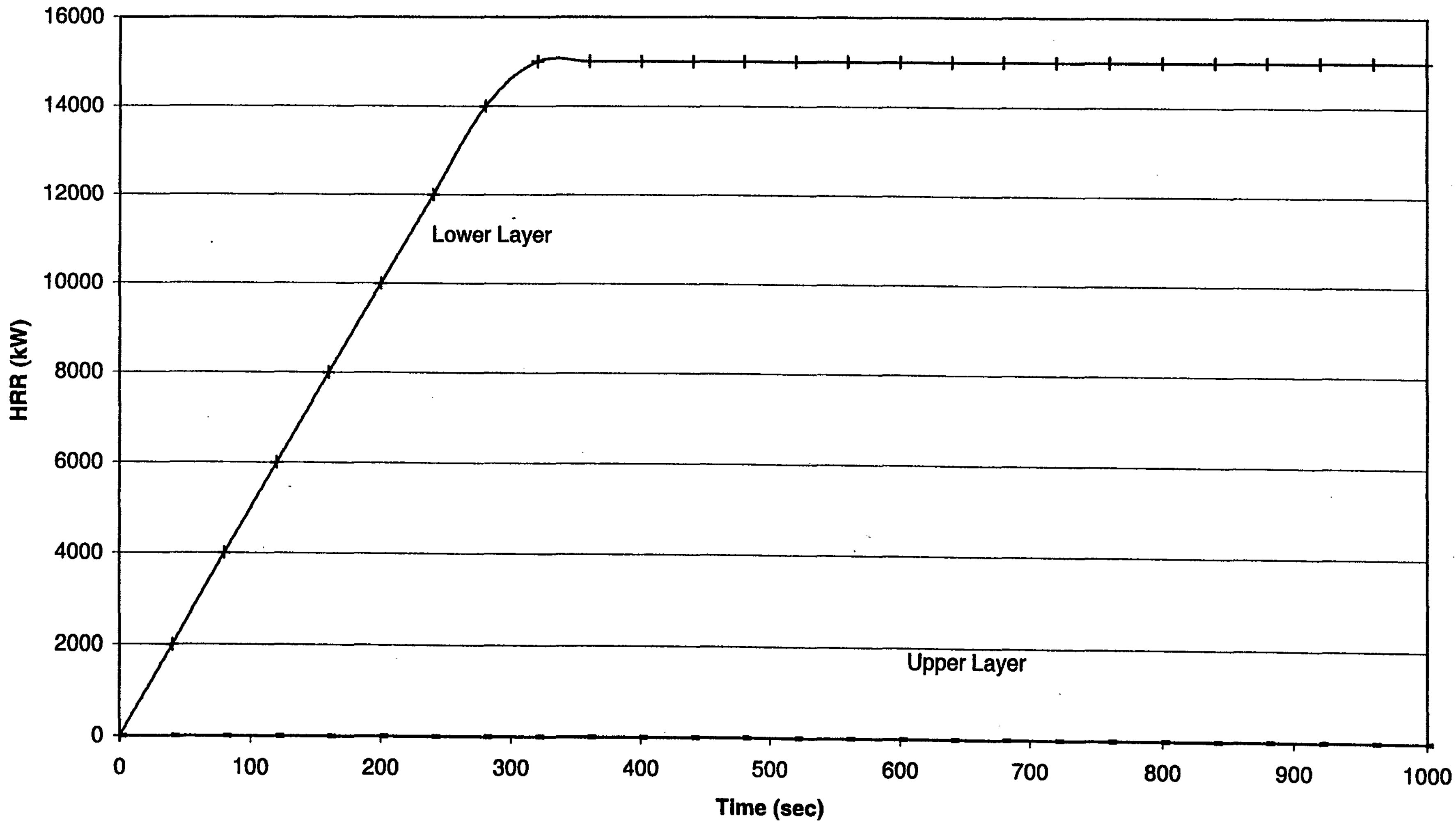
Upper Layer Temperature
Well Deck fire
LCAC supply, FS AE mechanical ventilation , stern gates open



Layer Height
Well Deck fire
LCAC supply, FS AE mechanical ventilation , stern gates open



HRR, Well Deck
Well Deck fire
LCAC supply, FS AE mechanical ventilation , stern gates open



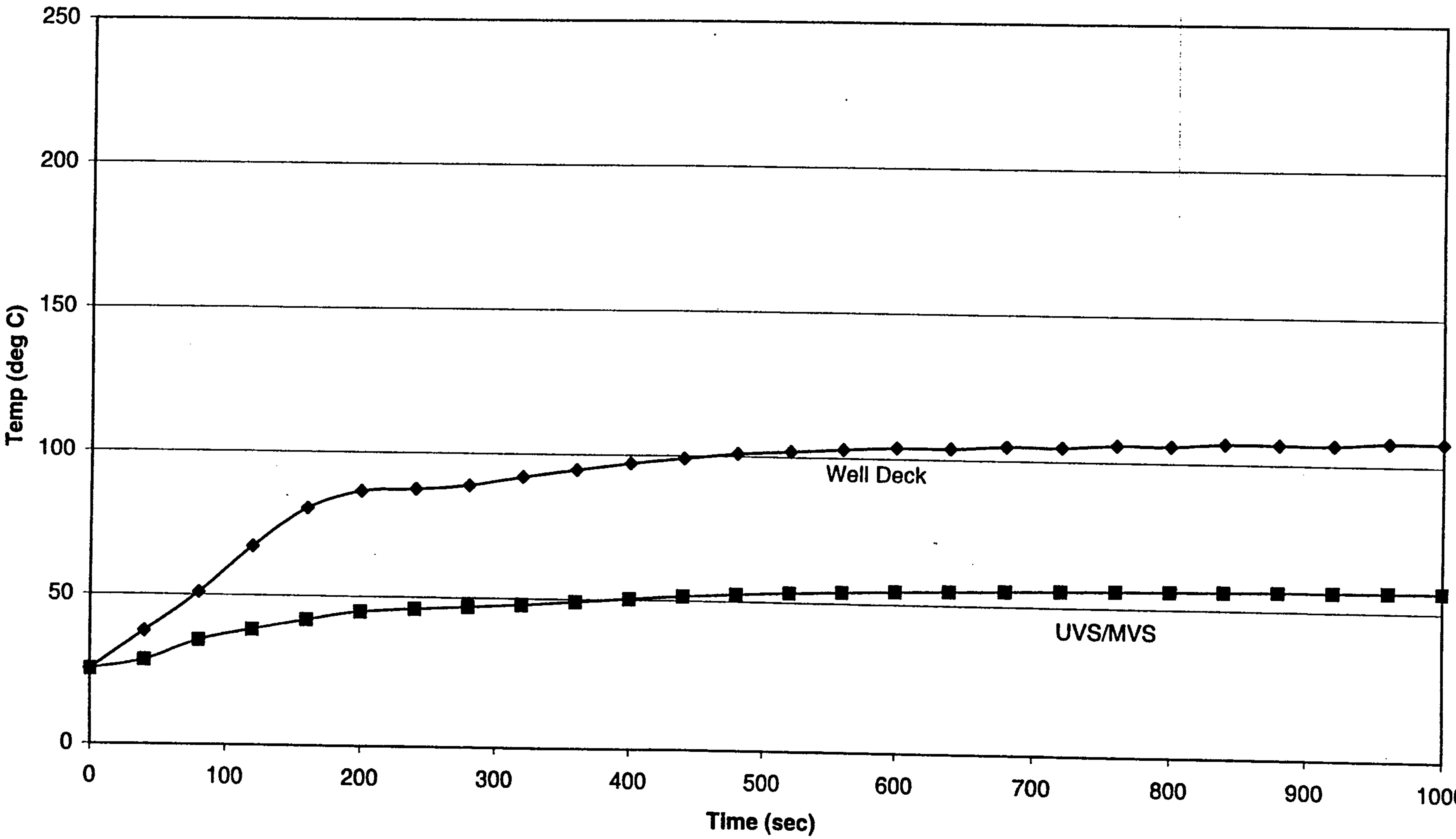
File: lpd17ccc.in
TSG: closed
BSG: closed
Fire Location: well deck

LCAC: off
Fans: FS
Opening: 2.8 x 5.0

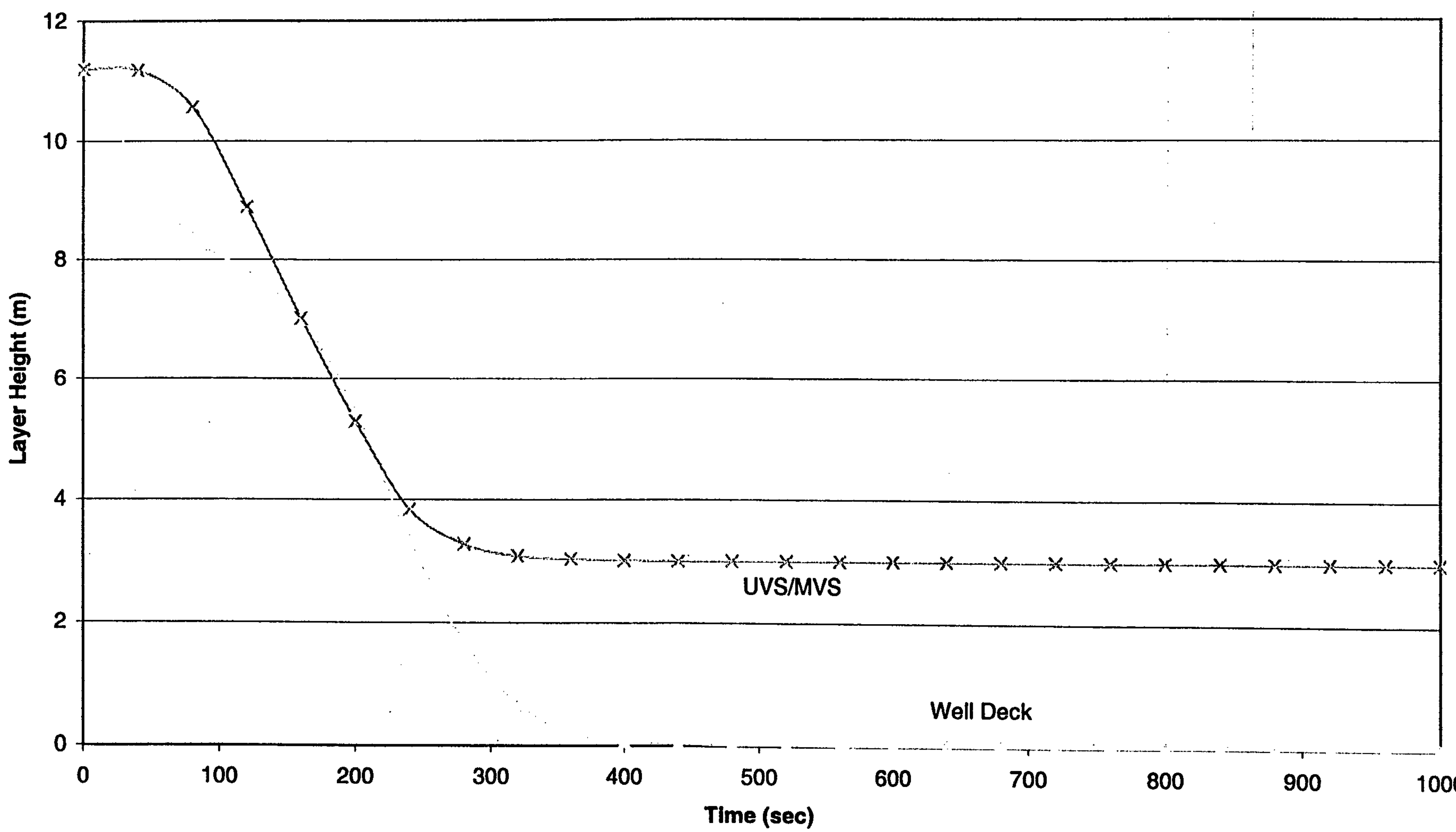
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	37.8	28.1	9.59	11.18	20.4	20.5	2000	0	0	0
80	50.9	34.9	8.36	10.57	20.2	20.4	4000	0	0	0
120	66.8	38.7	7.82	8.89	20	20.3	6000	0	0	0
160	80.1	42.2	7	7.02	19.8	20.2	8000	0	0	0
200	86.4	45.1	5.46	5.29	19.7	20.2	10000	0	0	0
240	87.3	46.2	3.33	3.84	19.6	20.1	12000	0	0	0
280	88.8	47.1	1.68	3.27	19.6	20.1	14000	0	0	0
320	92	48.1	0.67	3.08	19.5	20.1	15000	0	0	0
360	94.7	49.3	0.21	3.03	19.5	20.1	15000	0	0	0
400	97.1	50.5	0.06	3.01	19.4	20	5241	0	9755	0
440	99.1	51.6	0.03	3	19.4	20	1564	0	13430	0
480	101	52.5	0.01	3	19.4	20	83.2	0	14910	0
520	102	53.3	0.01	3	19.4	20	0	0	15000	0
560	103	53.9	0	3	19.3	20	0	0	15000	0
600	104	54.4	0	3	19.3	20	0	0	15000	0
640	104	54.8	0	3	19.3	20	0	0	15000	0
680	105	55.2	0	3	19.3	19.9	0	0	15000	0
720	105	55.5	0	3	19.3	19.9	0	0	15000	0
760	106	55.8	0	3	19.3	19.9	0	0	15000	0
800	106	56	0	3	19.3	19.9	0	0	15000	0
840	107	56.2	0	3	19.3	19.9	0	0	15000	0
880	107	56.4	0	3	19.3	19.9	0	0	15000	0
920	107	56.5	0	3	19.3	19.9	0	0	15000	0
960	108	56.7	0	3	19.3	19.9	0	0	15000	0
1000	108	56.8	0	3	19.3	19.9	0	0	15000	0

```
VERSN     3  Scenario 13
TIMES 1000  40    40    40     0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1    2.8  5.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17ccc.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

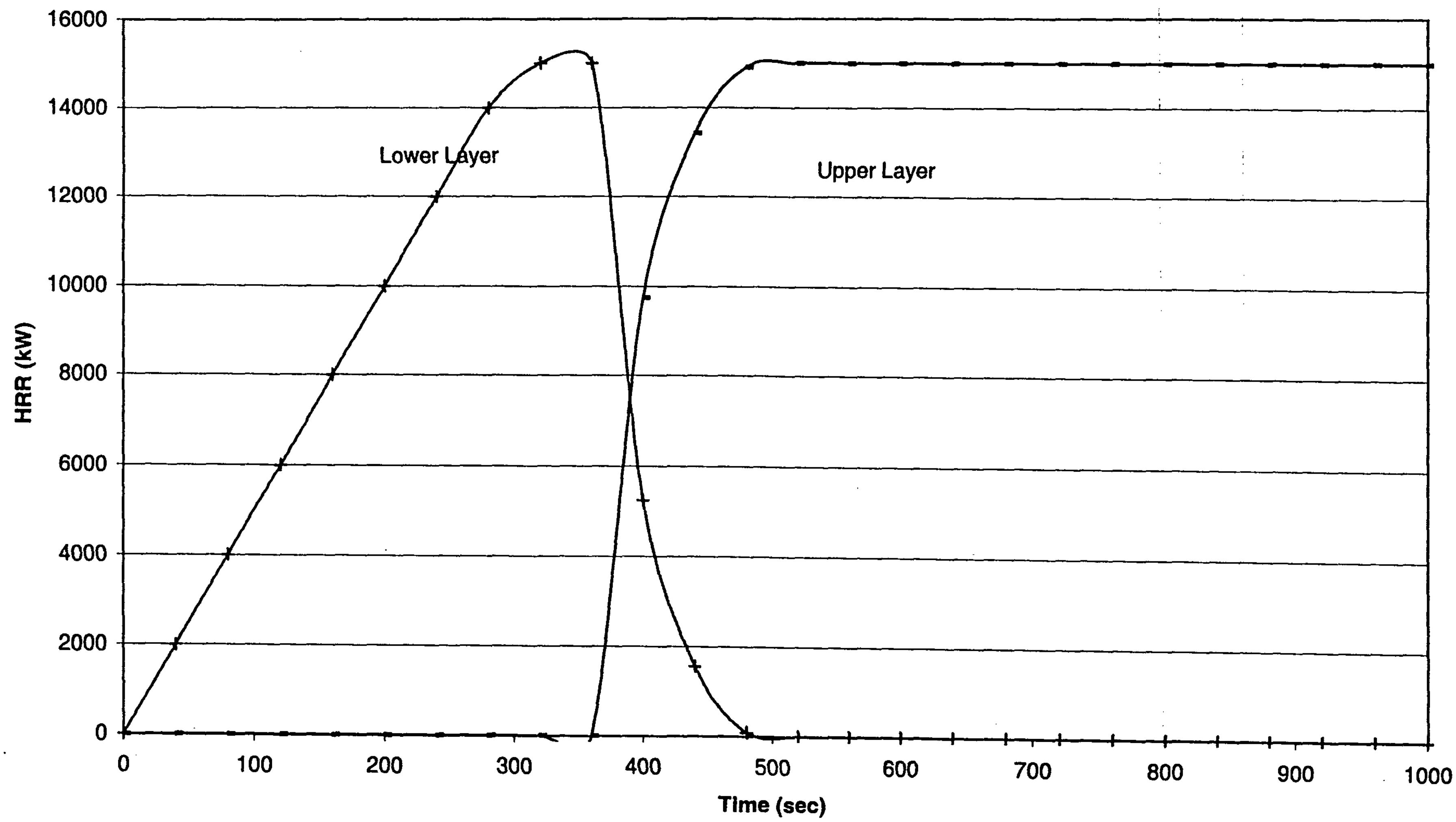
Upper Layer Temperature
Well Deck fire
LCAC off, FS mechanical ventilation, stern gates closed



Layer Height
Well Deck fire
LCAC off, FS mechanical ventilation, stern gates closed



HRR, Well Deck
Well Deck fire
LCAC off, FS mechanical ventilation, stern gates closed



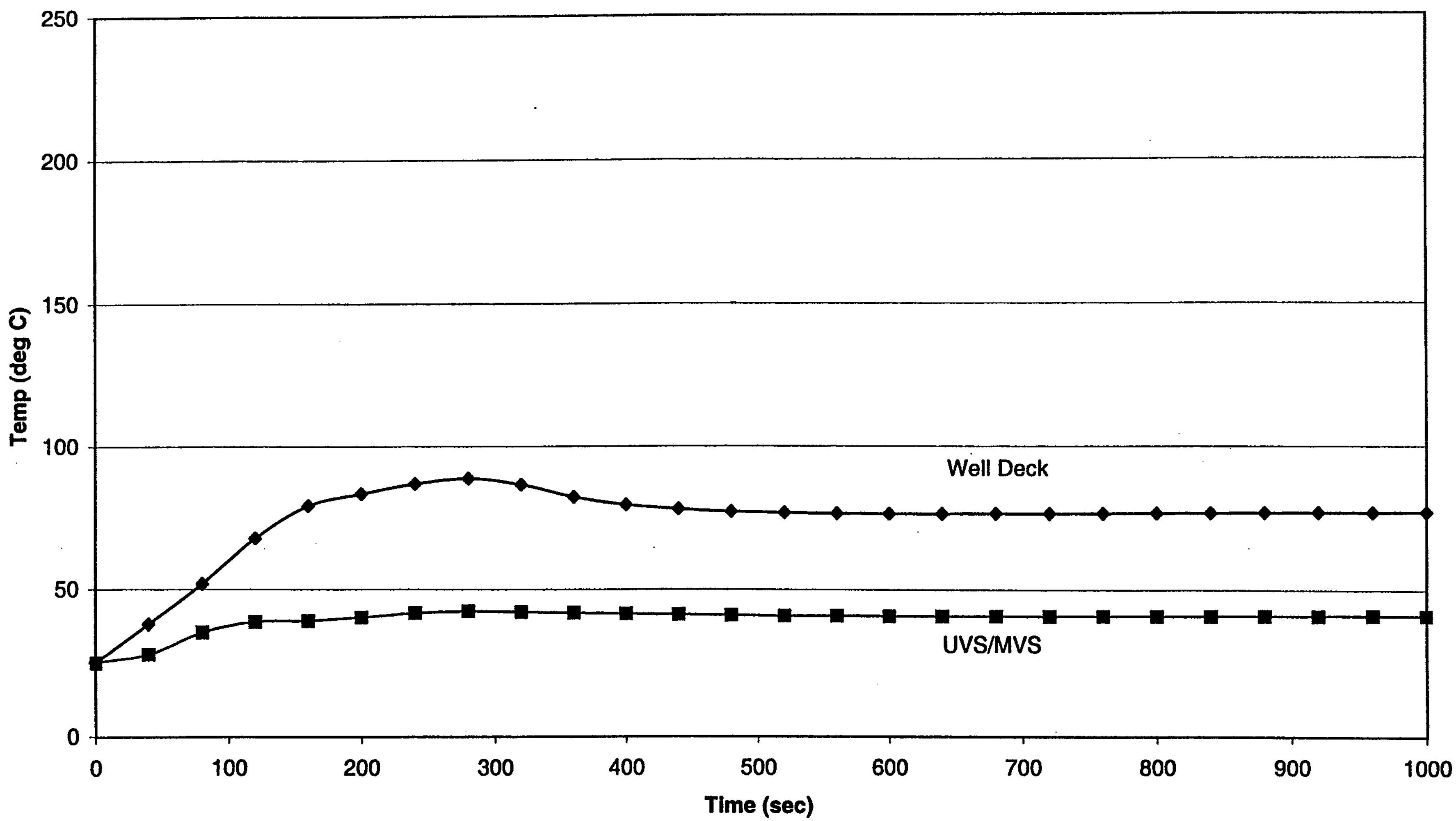
File: lpd17ddd.in
TSG: open
BSG: open
Fire Location: well deck

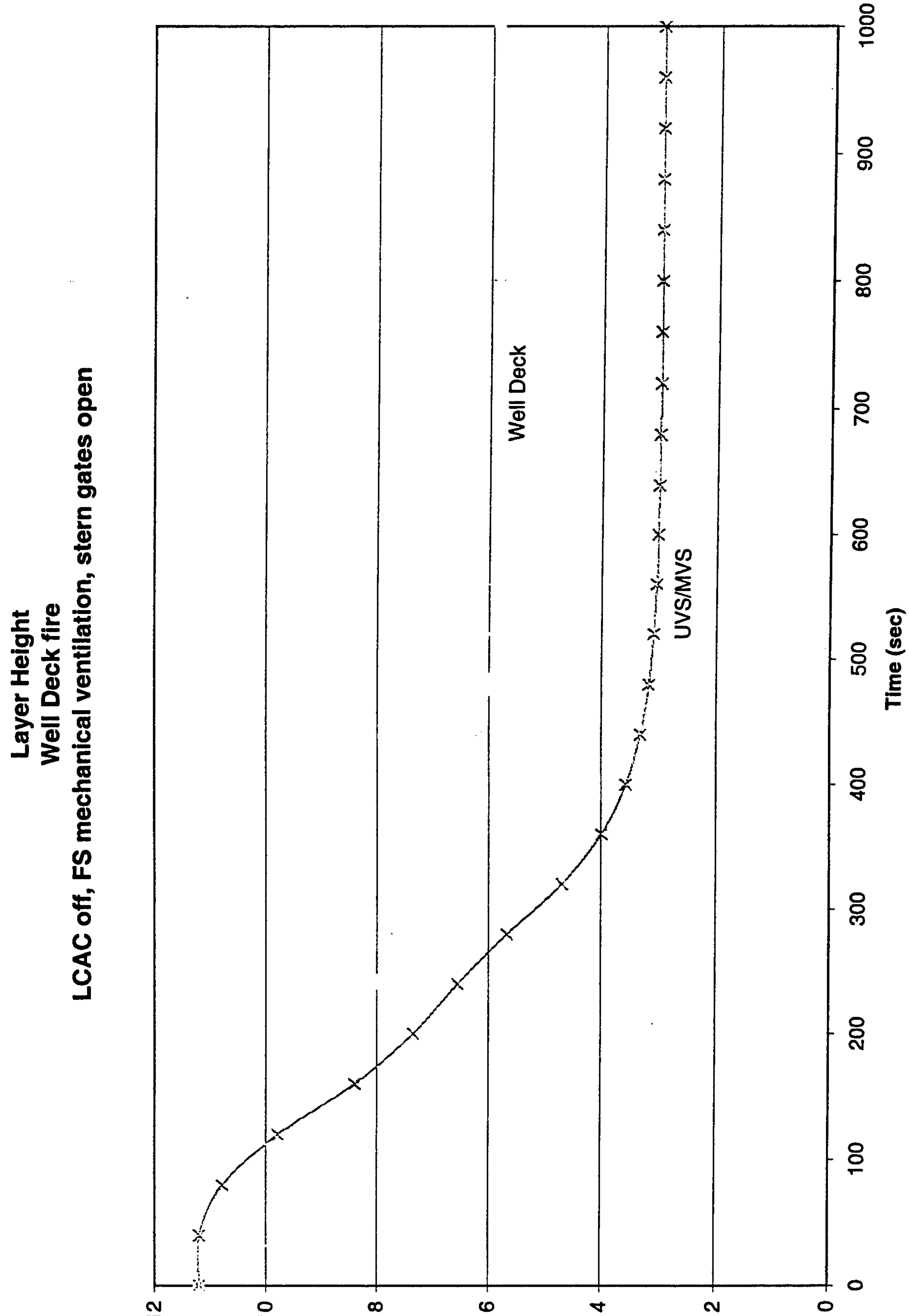
LCAC: off
Fans: FS
Opening: 2.8 x 5.0

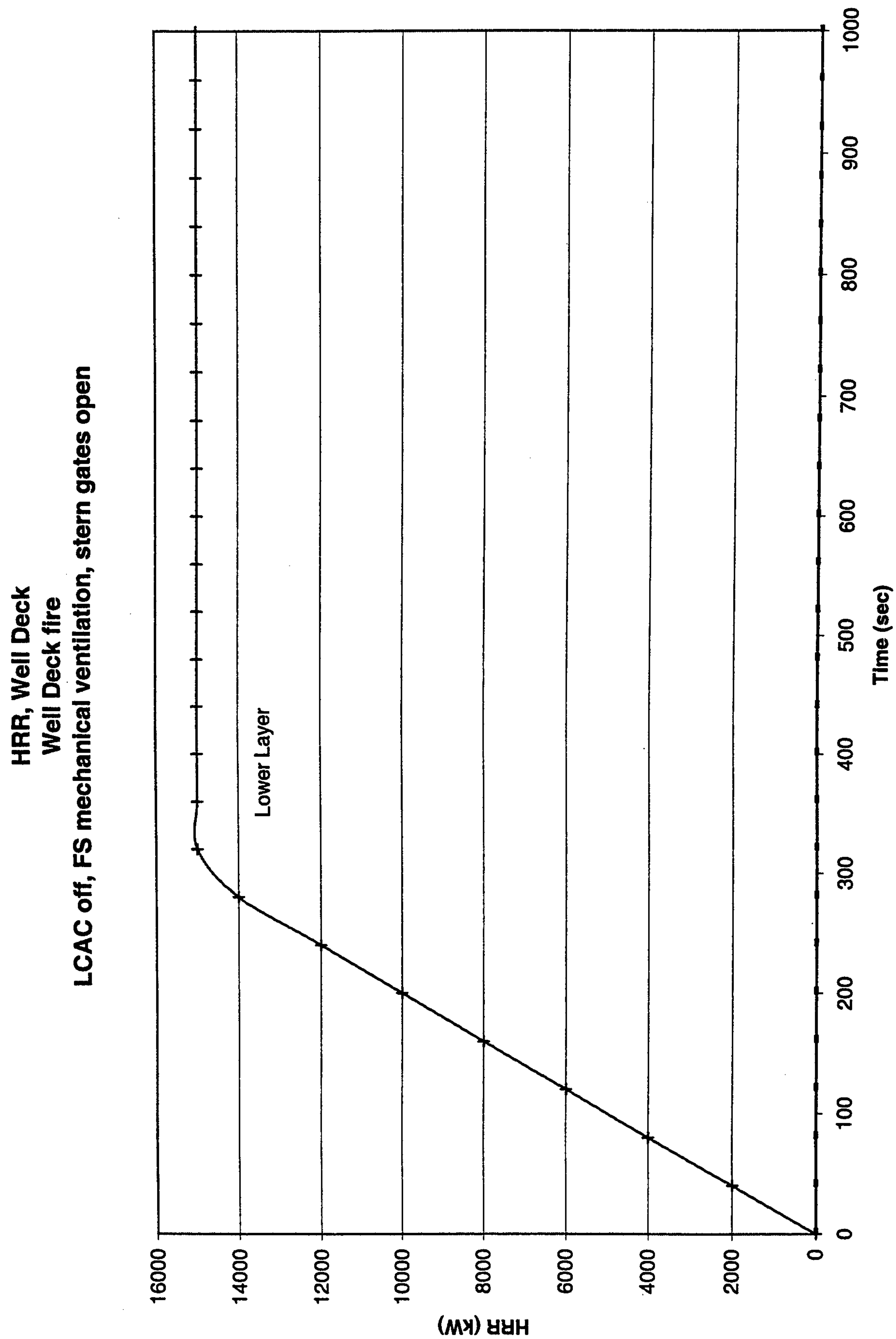
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	38	27.7	9.77	11.19	20.4	20.5	2000	0	0	0
80	51.9	35.3	9.13	10.78	20.2	20.4	4000	0	0	0
120	67.8	38.9	9.1	9.78	20	20.3	6000	0	0	0
160	79.1	39.2	8.88	8.4	19.8	20.3	8000	0	0	0
200	83.3	40.4	8.44	7.35	19.7	20.2	10000	0	0	0
240	86.8	41.9	8.06	6.55	19.7	20.2	12000	0	0	0
280	88.7	42.5	7.66	5.67	19.6	20.2	14000	0	0	0
320	86.6	42.3	7.13	4.69	19.7	20.2	15000	0	0	0
360	82.2	42	6.66	3.99	19.7	20.2	15000	0	0	0
400	79.5	41.7	6.33	3.57	19.8	20.2	15000	0	0	0
440	78	41.4	6.12	3.32	19.8	20.2	15000	0	0	0
480	77.1	41.2	6	3.18	19.8	20.2	15000	0	0	0
520	76.7	41	5.94	3.1	19.9	20.2	15000	0	0	0
560	76.4	41	5.9	3.05	19.9	20.2	15000	0	0	0
600	76.3	40.9	5.88	3.03	19.9	20.2	15000	0	0	0
640	76.3	40.9	5.87	3.02	19.9	20.2	15000	0	0	0
680	76.4	40.9	5.86	3.01	19.9	20.2	15000	0	0	0
720	76.4	40.9	5.86	3	19.9	20.2	15000	0	0	0
760	76.5	41	5.86	3	19.9	20.2	15000	0	0	0
800	76.6	41	5.87	3	19.9	20.2	15000	0	0	0
840	76.7	41	5.87	3	19.9	20.2	15000	0	0	0
880	76.8	41.1	5.88	3	19.9	20.2	15000	0	0	0
920	76.9	41.1	5.88	3	19.9	20.2	15000	0	0	0
960	76.9	41.2	5.89	3	19.9	20.2	15000	0	0	0
1000	77	41.2	5.9	3	19.9	20.2	15000	0	0	0

```
VERSN    3  Scenario 14
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5  11.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6   6.0  7  6.0  8   6.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17ddd.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.    10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.    10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0  0  0  0 2   1 U
TEMPERA 0  0  0  0 2   1 L
TEMPERA 0  0  0  0 2   2 L
```

Upper Layer Temperature
Well Deck fire
LCAC off, FS mechanical ventilation, stern gates open




Layer Height
Well Deck fire
LCAC off, FS mechanical ventilation, stern gates open
Layer Height (m)
Time (sec)
Well Deck
UVS/MVS
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000

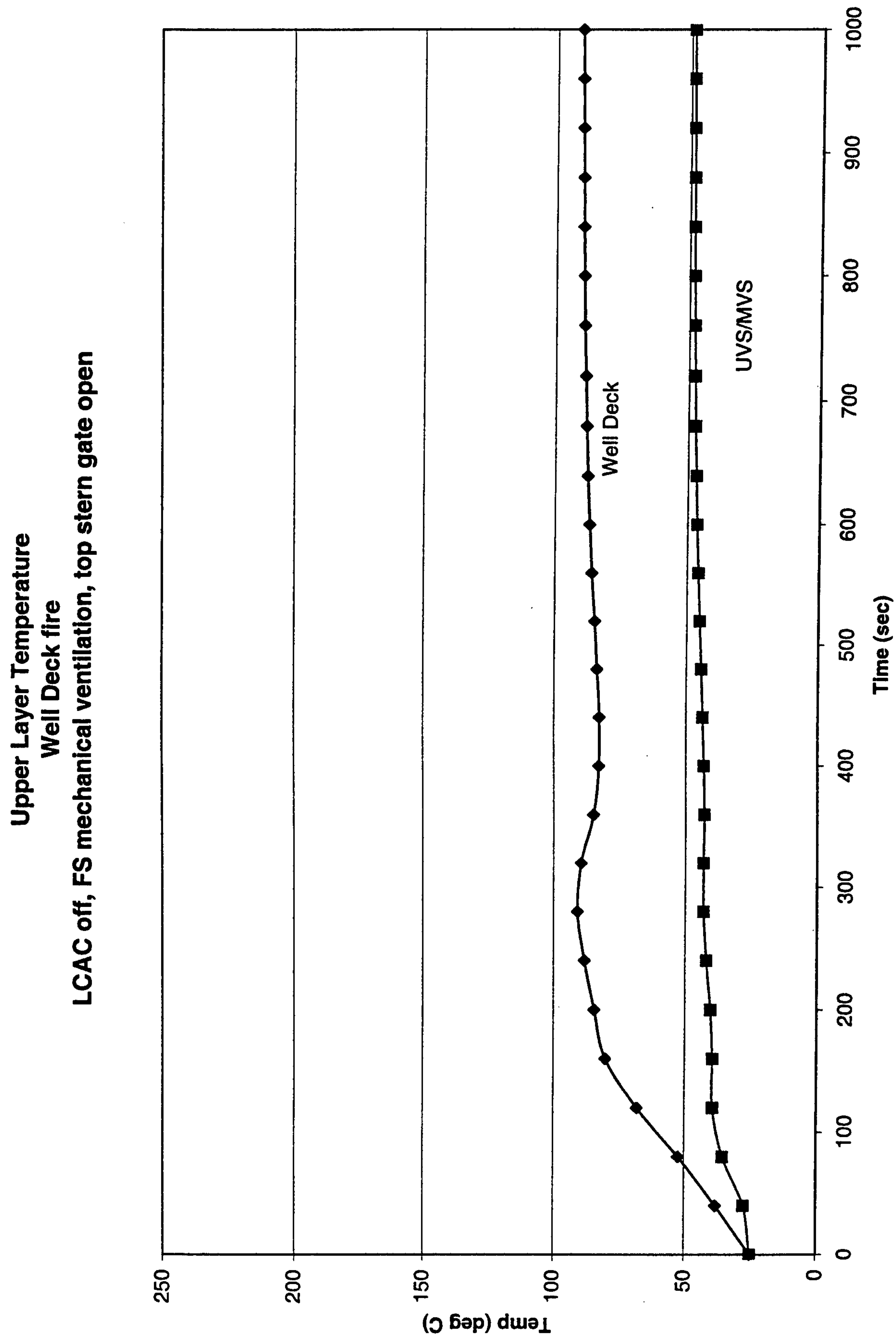

HRR, Well Deck
Well Deck fire
LCAC off, FS mechanical ventilation, stern gates open
Lower Layer
HRR (kW)
Time (sec)
0
2000
4000
6000
8000
10000
12000
14000
16000
0
100
200
300
400
500
600
700
800
900
1000

File: lpd17eee.in
TSG: open
BSG: closed
Fire Location: well deck

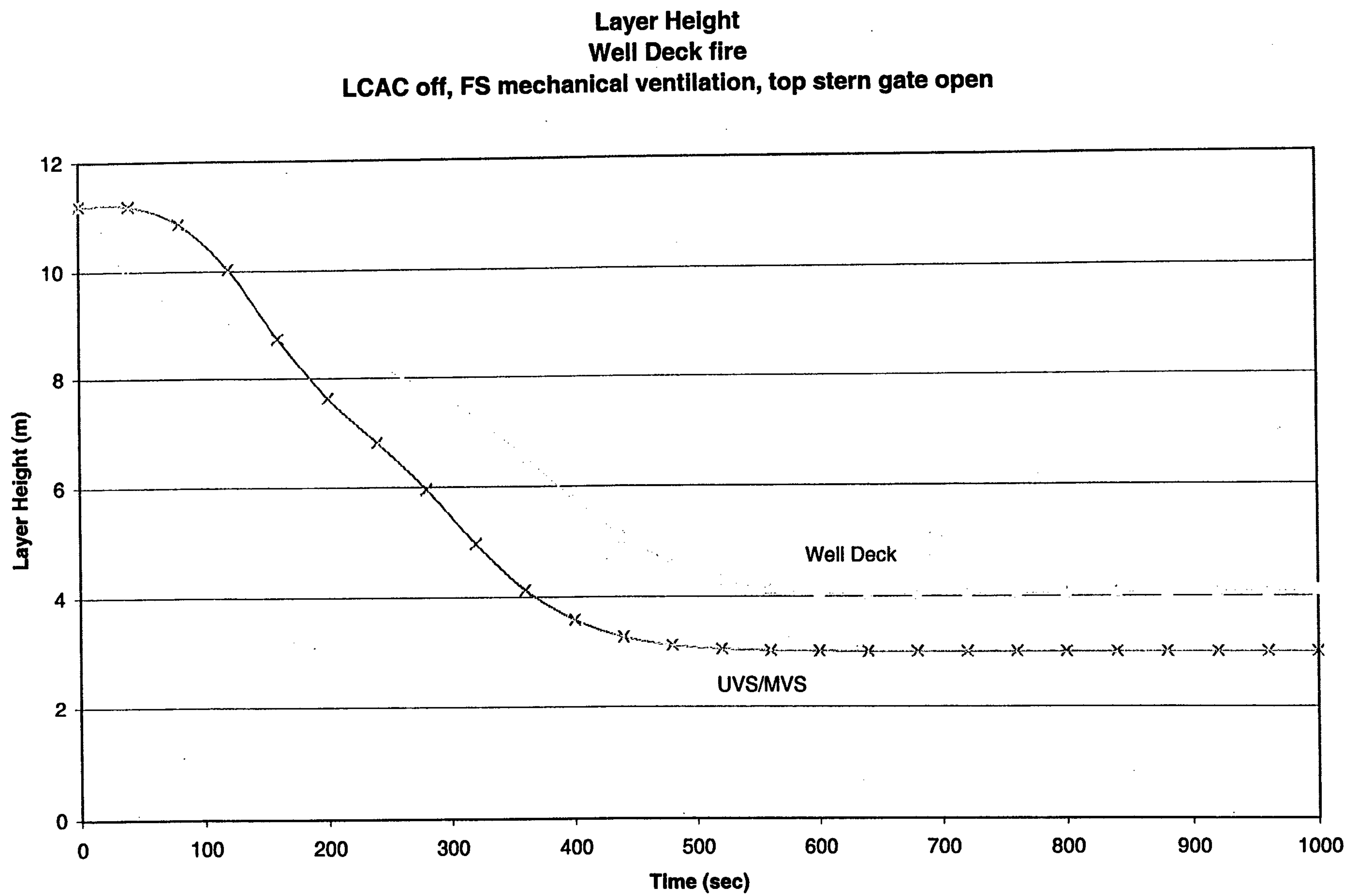
LCAC: off
Fans: FS
Opening: 2.8 x 5.0

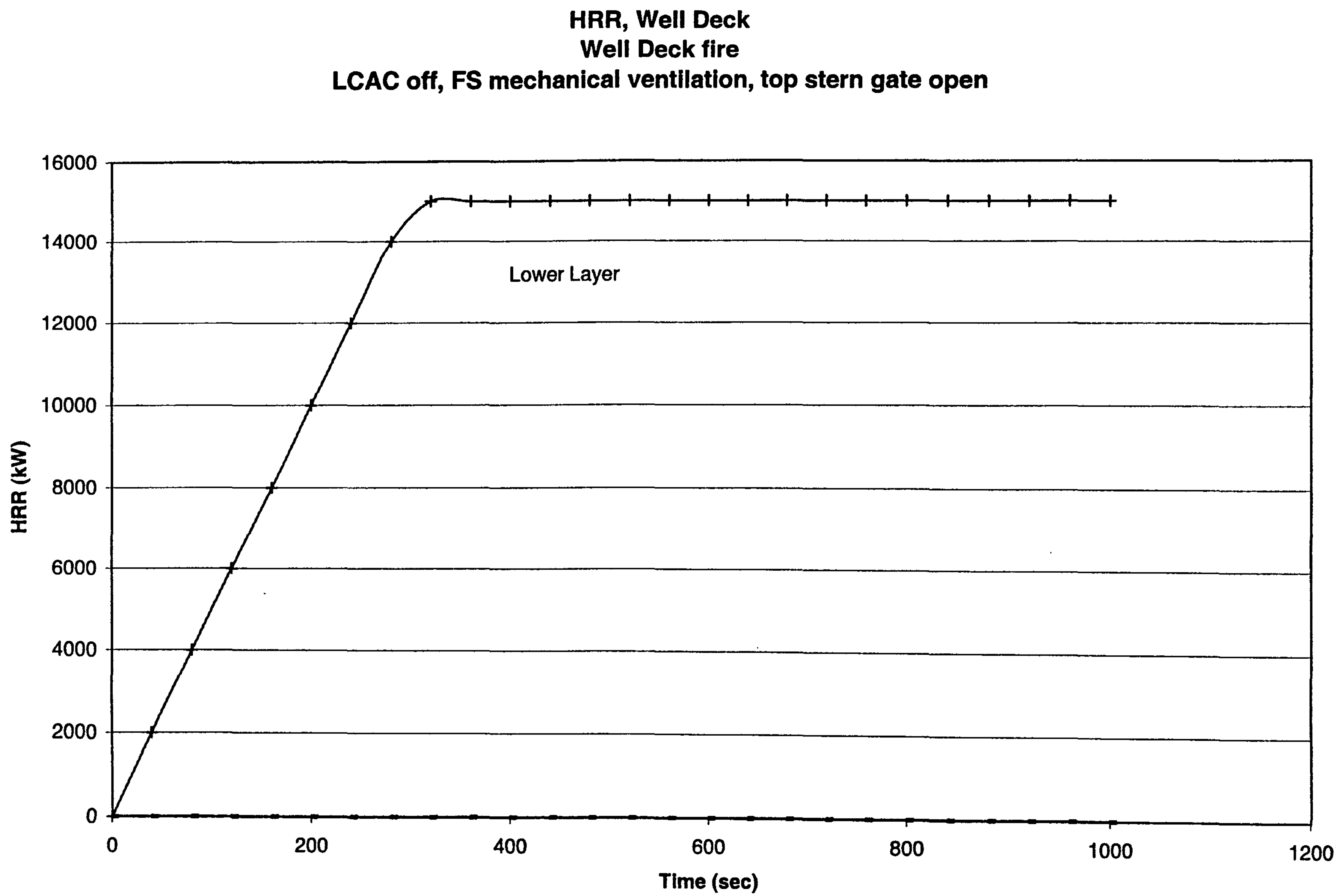
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	38.2	27.4	9.9	11.19	20.4	20.5	2000	0	0	0
80	52.4	35.5	9.36	10.86	20.2	20.4	4000	0	0	0
120	68	39.4	9.29	10.03	20	20.3	6000	0	0	0
160	80.1	39.5	9.09	8.74	19.8	20.2	8000	0	0	0
200	84.4	40.3	8.63	7.63	19.7	20.2	10000	0	0	0
240	88.1	42	8.21	6.81	19.7	20.2	12000	0	0	0
280	90.8	43.1	7.8	5.96	19.6	20.2	14000	0	0	0
320	89.4	43.2	7.26	4.97	19.6	20.2	15000	0	0	0
360	84.8	42.9	6.55	4.13	19.7	20.2	15000	0	0	0
400	82.8	43.2	5.76	3.59	19.7	20.2	15000	0	0	0
440	82.7	43.7	5.08	3.27	19.7	20.2	15000	0	0	0
480	83.6	44.4	4.6	3.12	19.7	20.1	15000	0	0	0
520	84.7	45.1	4.31	3.05	19.7	20.1	15000	0	0	0
560	85.9	45.8	4.15	3.02	19.7	20.1	15000	0	0	0
600	86.8	46.4	4.08	3.01	19.7	20.1	15000	0	0	0
640	87.6	46.9	4.05	3	19.7	20.1	15000	0	0	0
680	88.2	47.3	4.05	3	19.7	20.1	15000	0	0	0
720	88.7	47.6	4.06	3	19.7	20.1	15000	0	0	0
760	89.1	47.9	4.06	3	19.7	20.1	15000	0	0	0
800	89.4	48.1	4.07	3	19.7	20.1	15000	0	0	0
840	89.7	48.3	4.08	3	19.7	20.1	15000	0	0	0
880	89.9	48.4	4.09	3	19.7	20.1	15000	0	0	0
920	90.1	48.5	4.1	3	19.7	20.1	15000	0	0	0
960	90.3	48.6	4.1	3	19.7	20.1	15000	0	0	0
1000	90.5	48.7	4.11	3	19.7	20.1	15000	0	0	0

```
VERSN    3  Scenario 15
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5  11.0  6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
INELV   1   10.0  2   10.0  3  10.0  4   10.0
INELV   5   6.0  6    6.0  7  6.0  8   6.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR 1pd17eee.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```



Upper Layer Temperature
Well Deck fire
LCAC off, FS mechanical ventilation, top stern gate open
Temp (deg C)
0
50
100
150
200
250
Time (sec)
0
100
200
300
400
500
600
700
800
900
1000
Well Deck
UVS/MVS


Layer Height
Well Deck fire
LCAC off, FS mechanical ventilation, top stern gate open
Layer Height (m)
12
10
8
6
4
2
0
Well Deck
UVS/MVS
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)


HRR, Well Deck
Well Deck fire
LCAC off, FS mechanical ventilation, top stern gate open
16000
14000
12000
10000
8000
6000
4000
2000
0
HRR (kW)
Lower Layer
0
200
400
600
800
1000
1200
Time (sec)

File: lpd17fff.in
TSG: open
BSG: open
Fire Location: well deck

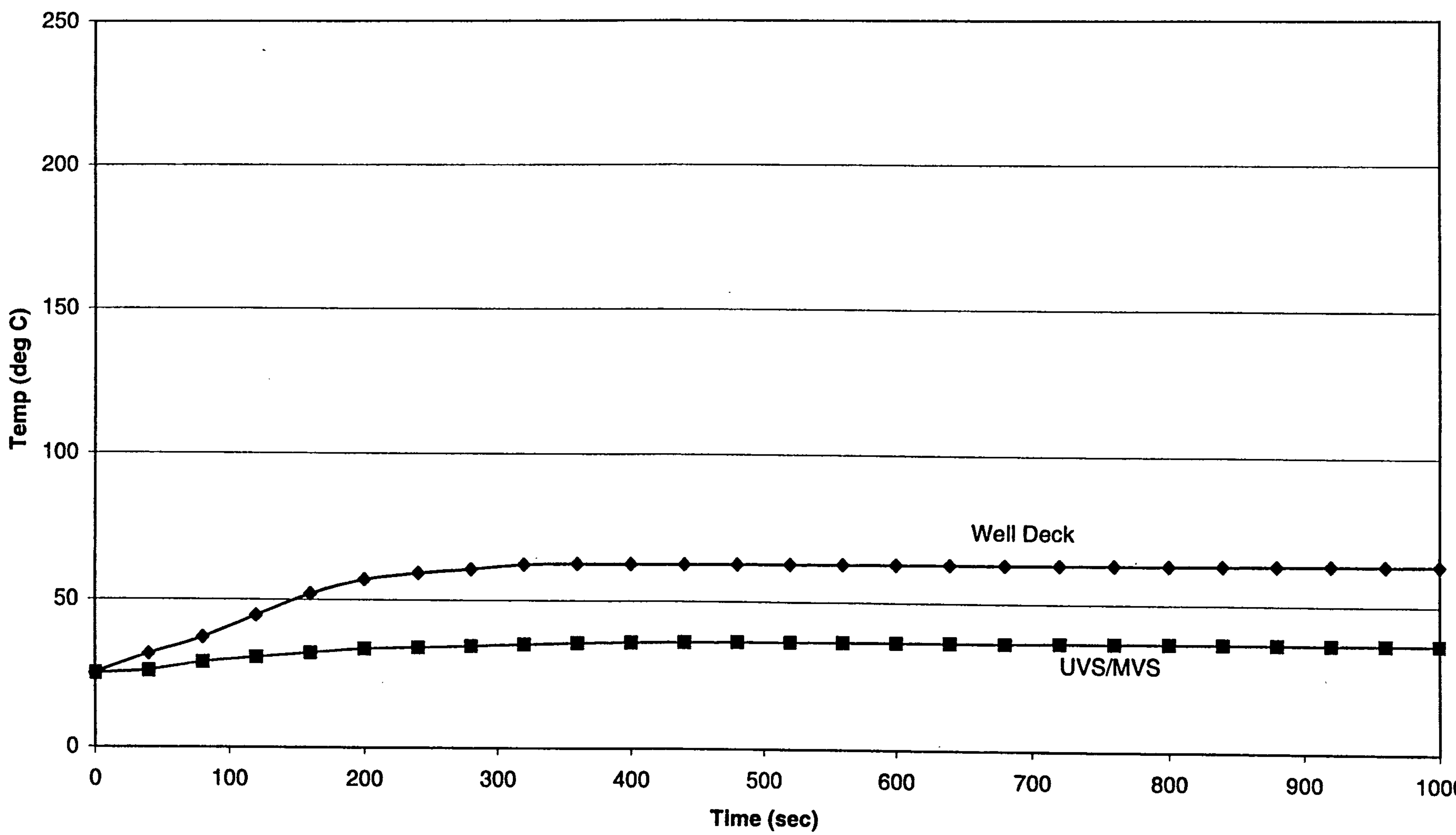
LCAC: supply
Fans: FS
Opening: 2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	31.6	25.9	8.64	11.19	20.4	20.7	2000	0	0	0
80	37.2	28.7	6.99	10.64	20.3	20.4	4000	0	0	0
120	44.7	30.5	6.89	9.25	20.2	20.4	6000	0	0	0
160	52	32	6.9	7.52	20.1	20.3	8000	0	0	0
200	56.9	33.5	6.52	6.19	20	20.3	10000	0	0	0
240	59.1	34	5.87	4.85	20	20.3	12000	0	0	0
280	60.5	34.5	5.19	3.91	20	20.3	14000	0	0	0
320	62.2	35.2	4.77	3.42	20	20.3	15000	0	0	0
360	62.4	35.7	4.57	3.19	20	20.3	15000	0	0	0
400	62.4	36	4.47	3.08	20	20.3	15000	0	0	0
440	62.4	36.2	4.43	3.04	20	20.3	15000	0	0	0
480	62.5	36.4	4.42	3.02	20	20.3	15000	0	0	0
520	62.6	36.4	4.42	3.01	20	20.3	15000	0	0	0
560	62.7	36.5	4.43	3	20	20.3	15000	0	0	0
600	62.8	36.6	4.43	3	20	20.3	15000	0	0	0
640	62.9	36.6	4.44	3	20	20.3	15000	0	0	0
680	62.9	36.6	4.45	3	20	20.3	15000	0	0	0
720	63	36.7	4.47	3	20	20.3	15000	0	0	0
760	63.1	36.7	4.48	3	20	20.3	15000	0	0	0
800	63.1	36.8	4.49	3	20	20.3	15000	0	0	0
840	63.2	36.8	4.5	3	20	20.3	15000	0	0	0
880	63.3	36.8	4.51	3	20	20.3	15000	0	0	0
920	63.4	36.8	4.52	3	20	20.3	15000	0	0	0
960	63.4	36.9	4.53	3	20	20.3	15000	0	0	0
1000	63.5	36.9	4.53	3	20	20.3	15000	0	0	0

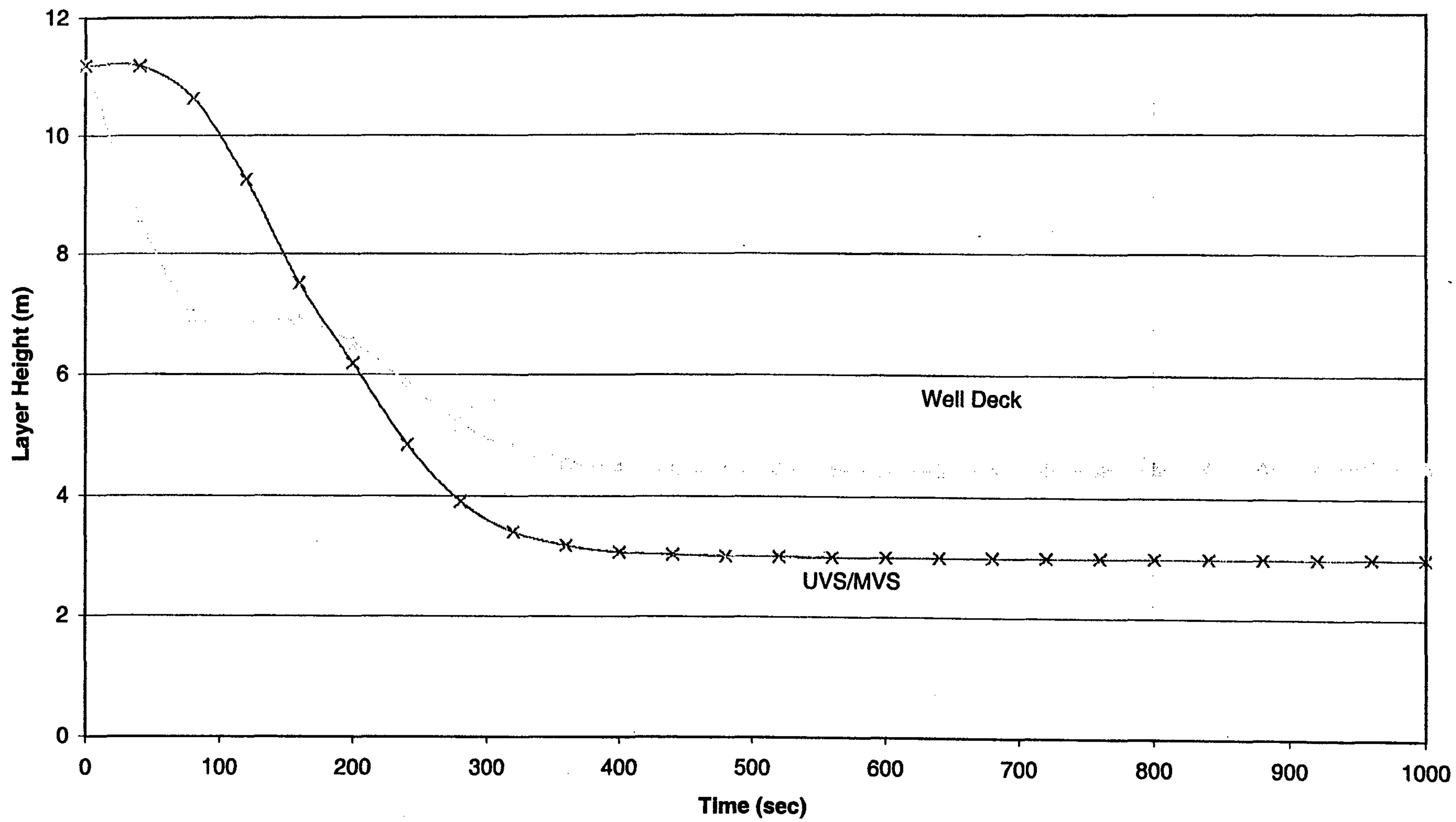
```
VERSN    3  Scenario 16
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.2  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   8.2  4.0
MVOPN  2  12 V  8.2  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  11 10   0.0  1000. 90
MVFAN  15 14   0.0  1000. 90
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   11.2  10   11.2  11  11.2  12   11.2
INELV    13   11.2  14   11.2  15  11.2  16   11.2
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
```

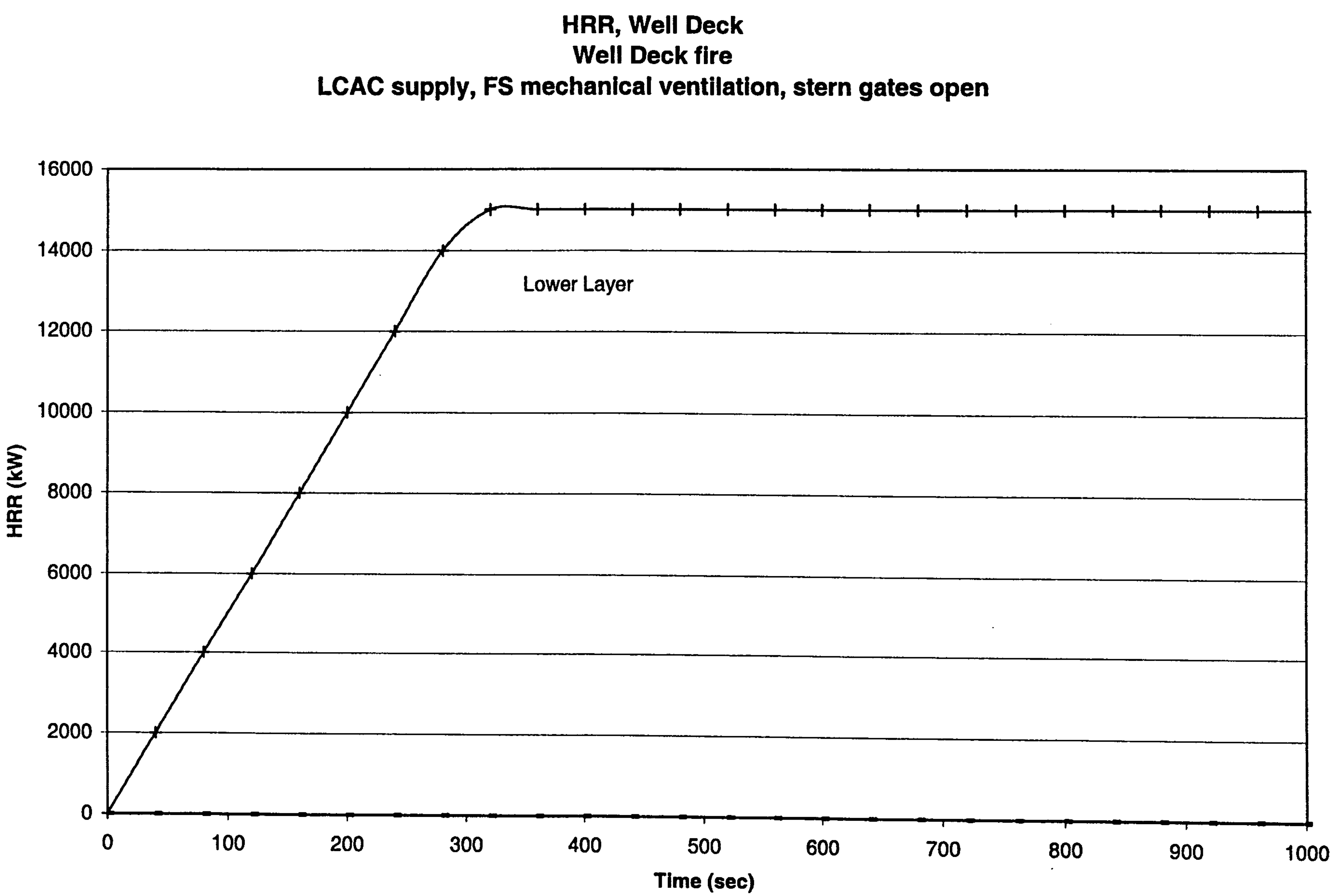
```
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17fff.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
Well Deck fire
LCAC supply, FS mechanical ventilation, stern gates open



Layer Height
Well Deck fire
LCAC supply, FS mechanical ventilation, stern gates open




HRR, Well Deck
Well Deck fire
LCAC supply, FS mechanical ventilation, stern gates open
16000
14000
12000
10000
8000
6000
4000
2000
0
HRR (kW)
Lower Layer
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)

File: lpd17ggg.in
TSG: open
BSG: closed
Fire Location: well deck

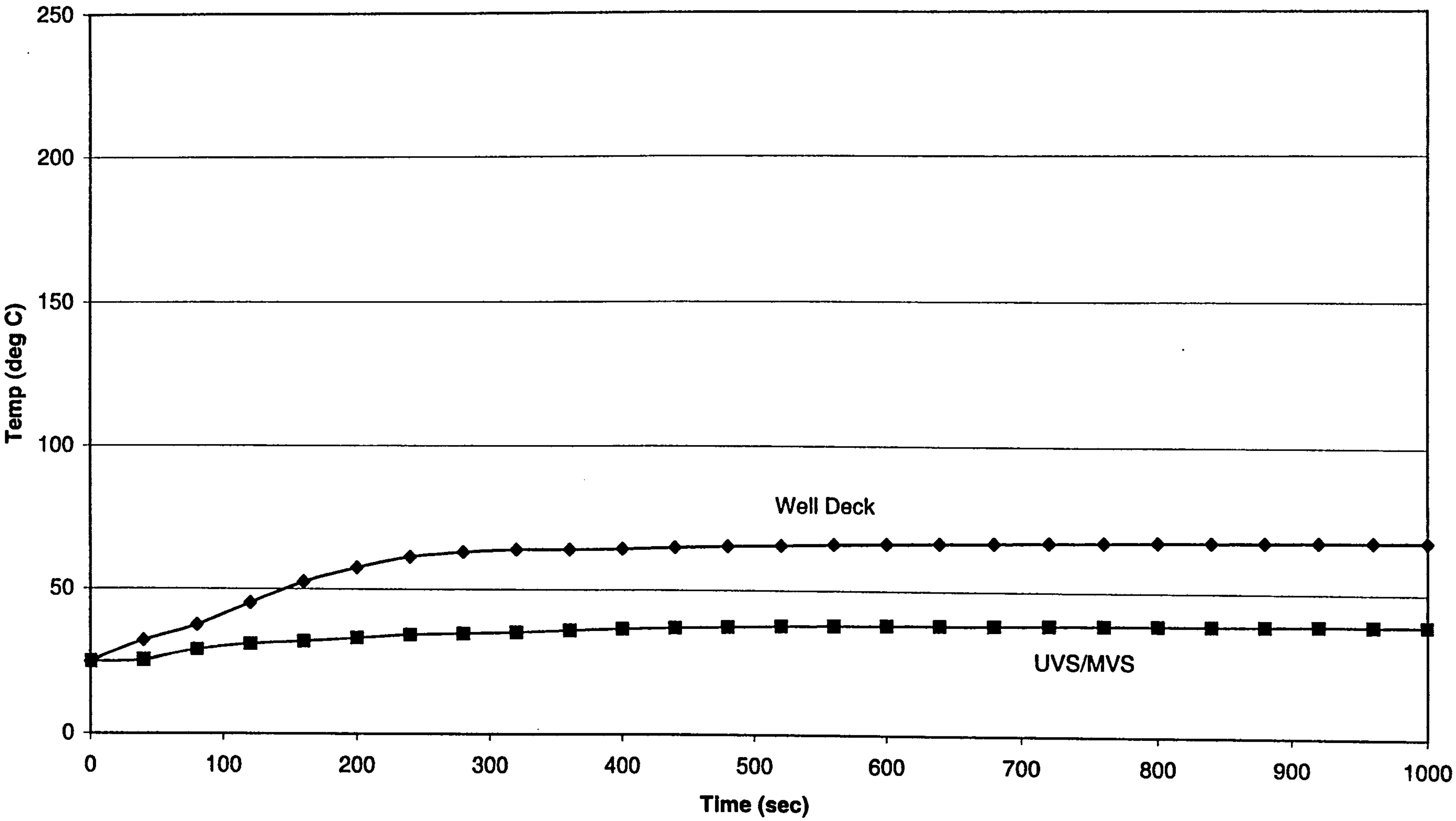
LCAC: supply
Fans: FS
Opening: 2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	32.3	25.5	9.3	11.2	20.4	20.9	2000	0	0	0
80	37.7	29.1	8.16	10.89	20.3	20.4	4000	0	0	0
120	45.2	31.1	8.05	10.02	20.2	20.4	6000	0	0	0
160	52.5	32.1	8	8.56	20.1	20.3	8000	0	0	0
200	57.5	33.3	7.66	7.25	20	20.3	10000	0	0	0
240	61.2	34.4	7.24	6.2	20	20.3	12000	0	0	0
280	63	34.9	6.6	5.03	19.9	20.3	14000	0	0	0
320	63.9	35.4	5.48	4.04	19.9	20.3	15000	0	0	0
360	64	36.1	4.43	3.47	19.9	20.3	15000	0	0	0
400	64.3	36.7	3.74	3.19	19.9	20.2	15000	0	0	0
440	64.8	37.1	3.27	3.07	19.9	20.2	15000	0	0	0
480	65.3	37.5	2.93	3.03	19.9	20.2	15000	0	0	0
520	65.6	37.8	2.66	3.01	19.9	20.2	15000	0	0	0
560	66	38	2.46	3	19.9	20.2	15000	0	0	0
600	66.3	38.2	2.31	3	19.9	20.2	15000	0	0	0
640	66.6	38.3	2.21	3	19.9	20.2	15000	0	0	0
680	66.8	38.4	2.14	3	19.9	20.2	15000	0	0	0
720	67	38.6	2.1	3	19.9	20.2	15000	0	0	0
760	67.2	38.7	2.07	3	19.9	20.2	15000	0	0	0
800	67.4	38.8	2.06	3	19.9	20.2	15000	0	0	0
840	67.5	38.8	2.05	3	19.9	20.2	14990	0	0	0
880	67.6	38.9	2.04	3	19.9	20.2	14990	0	0	0
920	67.8	39	2.05	3	19.9	20.2	14990	0	0	0
960	67.9	39	2.05	3	19.9	20.2	14990	0	0	0
1000	68	39.1	2.06	3	19.9	20.2	14990	0	0	0

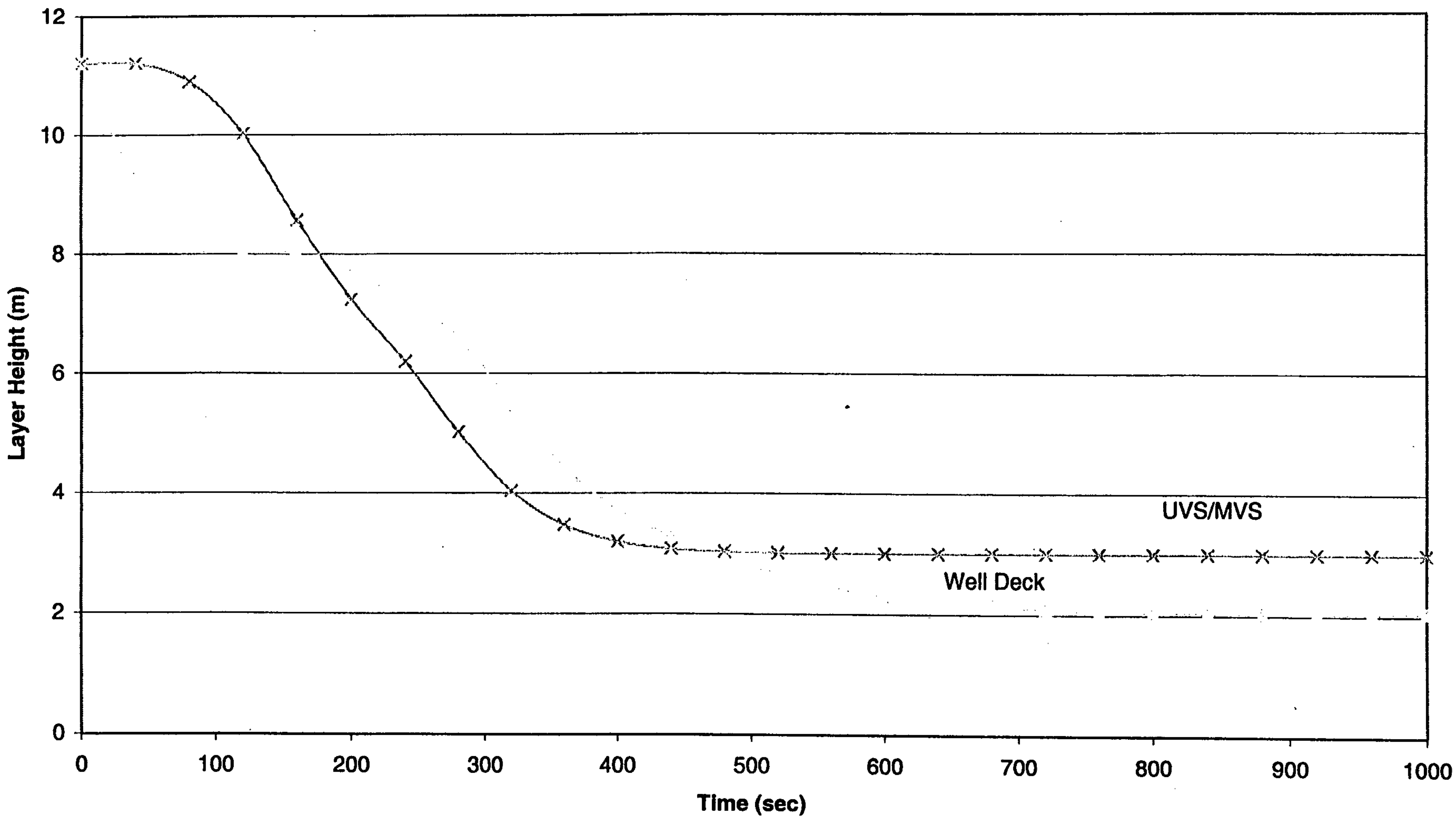
```
VERSN    3  Scenario 17
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.2  6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   8.2  4.0
MVOPN  2  12 V  8.2  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  11 10   0.0  1000. 90
MVFAN  15 14   0.0  1000. 90
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   11.2  10   11.2  11  11.2  12   11.2
INELV    13   11.2  14   11.2  15  11.2  16   11.2
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  1
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
```

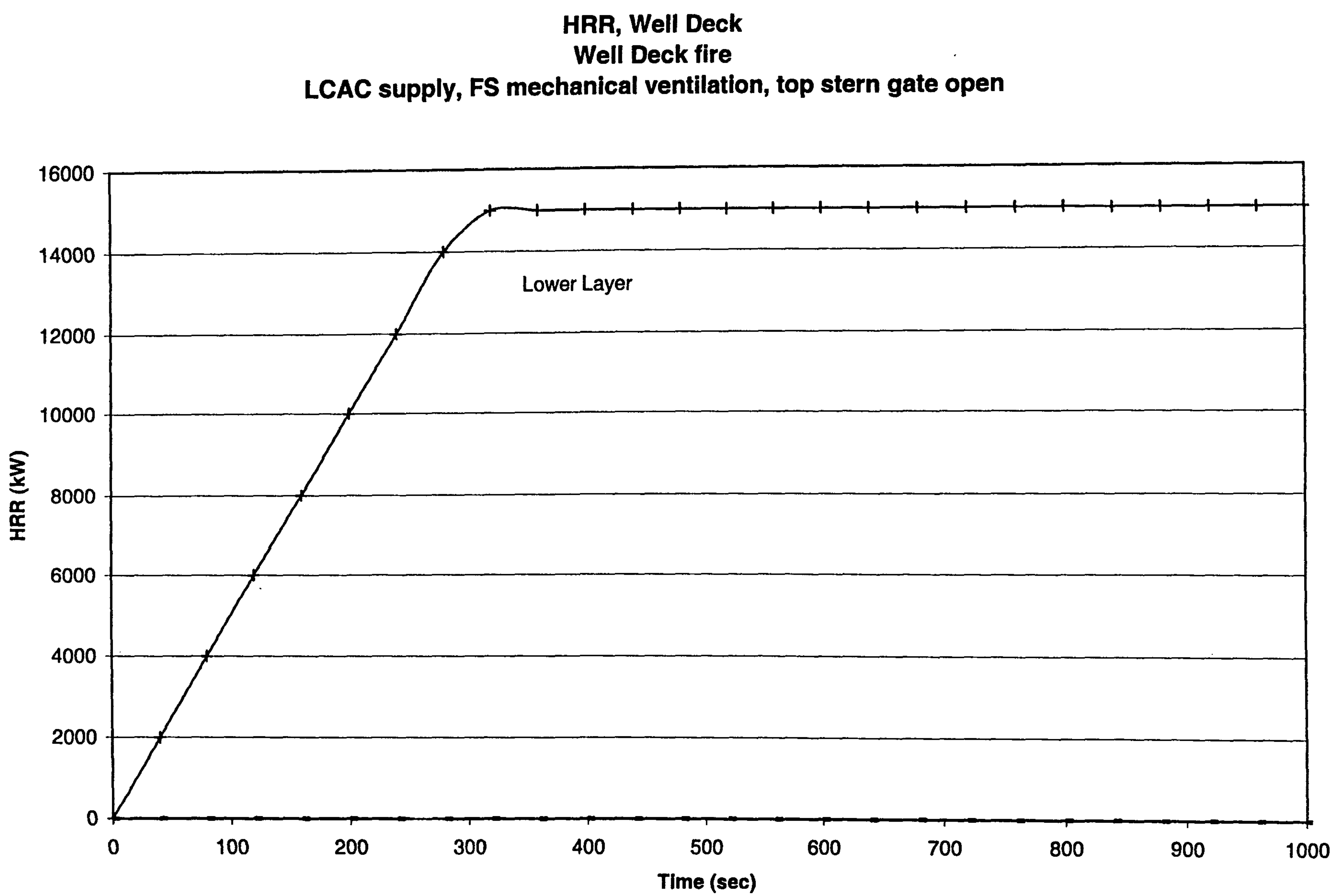
```
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR 1pd17ggg.hi
DEVICE 1
WINDOW        0      0  -100  1280  1024   1100
GRAPH   1  120.  300.     0.  600.  920.    10. 5 TIME  METERS
GRAPH   2  740.  300.     0.  1220. 920.    10. 5 TIME  CELSIUS
INTER   0 0 0 0 1    1 U
TEMPERA 0 0 0 0 2    1 U
TEMPERA 0 0 0 0 2    1 L
TEMPERA 0 0 0 0 2    2 L
```

Upper Layer Temperature
Well Deck fire
LCAC supply, FS mechanical ventilation, top stern gate open



Layer Height
Well Deck fire
LCAC supply, FS mechanical ventilation, top stern gate open



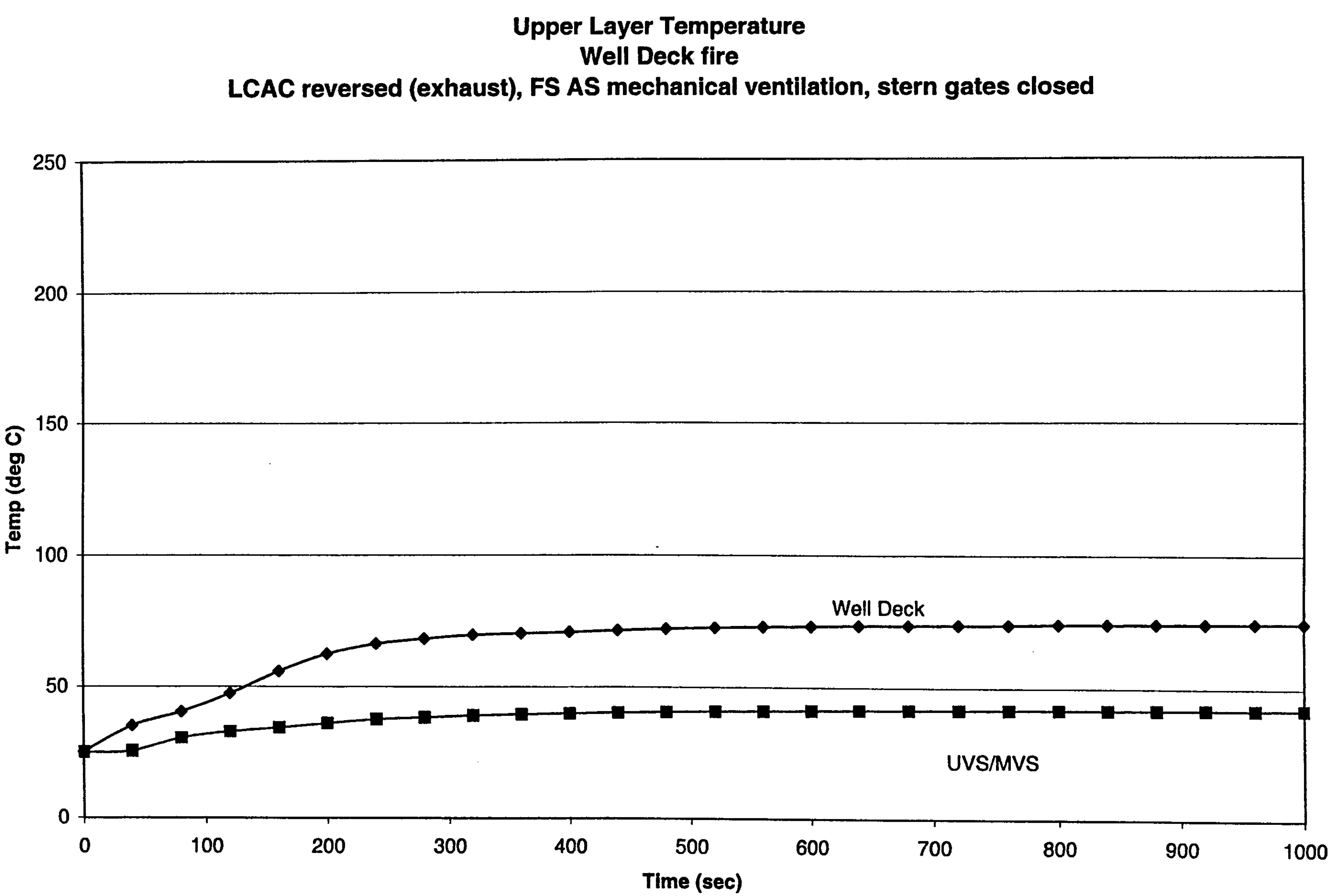

HRR, Well Deck
Well Deck fire
LCAC supply, FS mechanical ventilation, top stern gate open
16000
14000
12000
10000
8000
6000
4000
2000
0
HRR (kW)
Lower Layer
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)

File:	lpd17ooo.in		
TSG:	closed	**LCAC:**	exhaust
BSG:	closed	**Fans:**	FS, AS
Fire Location:	well deck	**Opening:**	2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	35.1	25.4	9.95	11.2	20.4	21.5	2000	0	0	0
80	40.3	30.4	8.88	11.01	20.3	20.4	4000	0	0	0
120	47.4	32.9	8.08	10.28	20.2	20.4	6000	0	0	0
160	55.8	34.4	7.64	8.73	20	20.3	8000	0	0	0
200	62.4	36.1	6.87	7.08	20	20.3	9999	0	0	0
240	66.3	37.6	5.47	5.52	19.9	20.2	12000	0	0	0
280	68.2	38.3	3.5	4.04	19.9	20.2	14000	0	0	0
320	69.7	39	1.89	3.37	19.8	20.2	15000	0	0	0
360	70.3	39.5	0.85	3.13	19.8	20.2	15000	0	0	0
400	70.8	39.9	0.31	3.05	19.8	20.2	15000	0	0	0
440	71.5	40.2	0.1	3.02	19.8	20.2	7935	0	7062	0
480	72.1	40.5	0.04	3.01	19.8	20.2	2832	0	12160	0
520	72.6	40.8	0.02	3	19.8	20.2	788	0	14210	0
560	72.9	41	0.01	3	19.8	20.2	0	0	15000	0
600	73.1	41.2	0.01	3	19.8	20.2	0	0	15000	0
640	73.4	41.3	0	3	19.8	20.2	0	0	15000	0
680	73.5	41.4	0	3	19.8	20.2	0	0	15000	0
720	73.7	41.5	0	3	19.8	20.2	0	0	15000	0
760	73.8	41.6	0	3	19.8	20.2	0	0	15000	0
800	74	41.7	0	3	19.8	20.2	0	0	15000	0
840	74.1	41.7	0	3	19.8	20.2	0	0	15000	0
880	74.2	41.8	0	3	19.8	20.2	0	0	15000	0
920	74.3	41.9	0	3	19.8	20.2	0	0	15000	0
960	74.4	41.9	0	3	19.8	20.2	0	0	15000	0
1000	74.5	42	0	3	19.8	20.2	0	0	15000	0

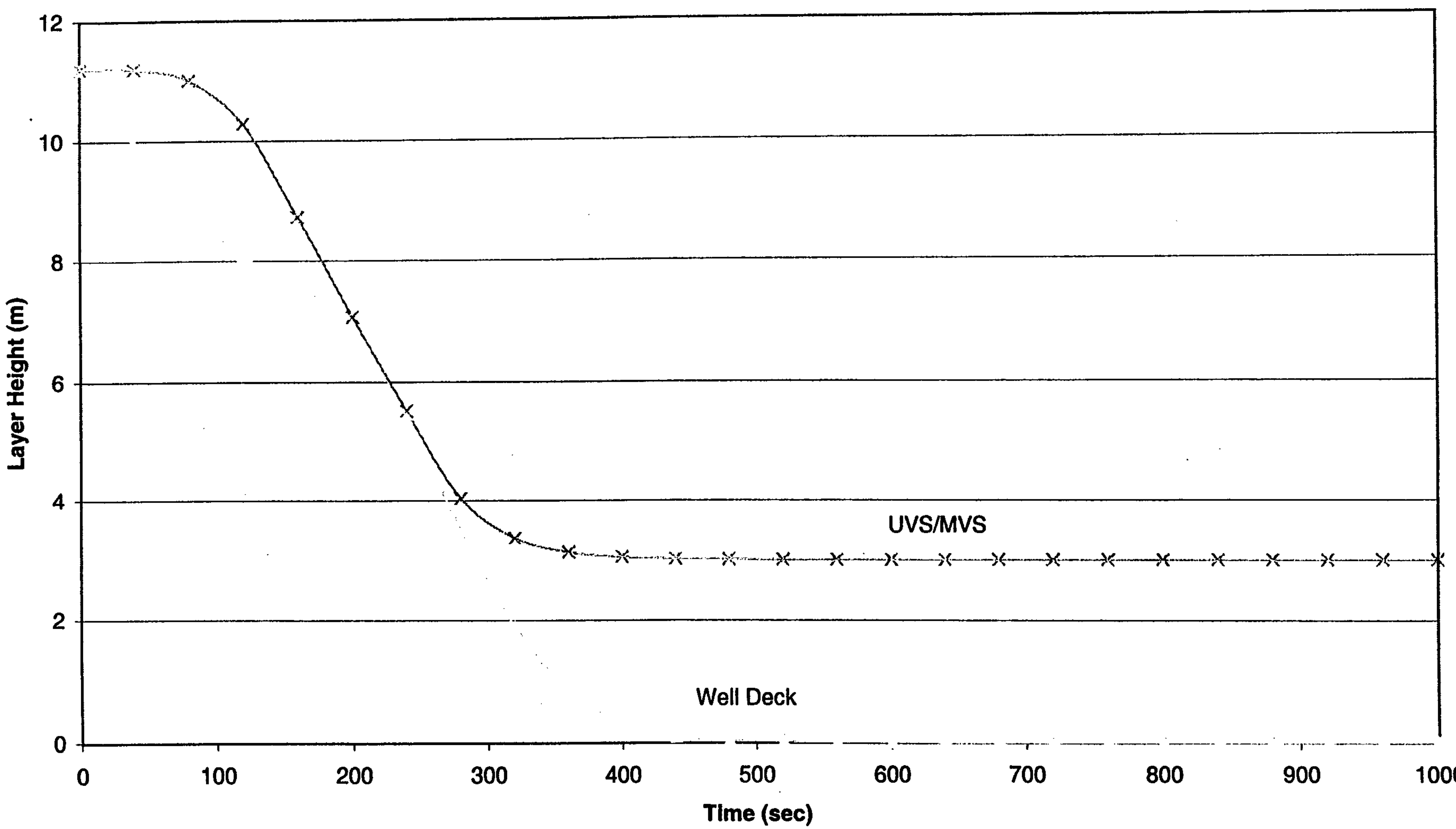
```
VERSN    3  Scenario 18
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   9.0  4.0
MVOPN  2  12 V  9.0  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVOPN  1  17 V   10.0  4.0
MVOPN  3  20 V  10.0  4.0
MVDCT  1  2    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  17 18    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  19 20    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2    0.0  1000. 42.5
MVFAN  7  6    0.0  1000. 42.5
MVFAN  10 11    0.0  1000. 90
MVFAN  14 15    0.0  1000. 90
MVFAN  19 18    0.0  1000. 75
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   12.0  10   12.0  11  12.0  12   12.0
INELV    13   11.2  14   11.2  15  11.2  16   11.2
INELV    17   10.0   18   10.0  19  10.0   20  10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO     .0072
LFBO  1
LFBT  2
OD    .022
```

```
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17ooo.hi
DEVICE 1
WINDOW       0      0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

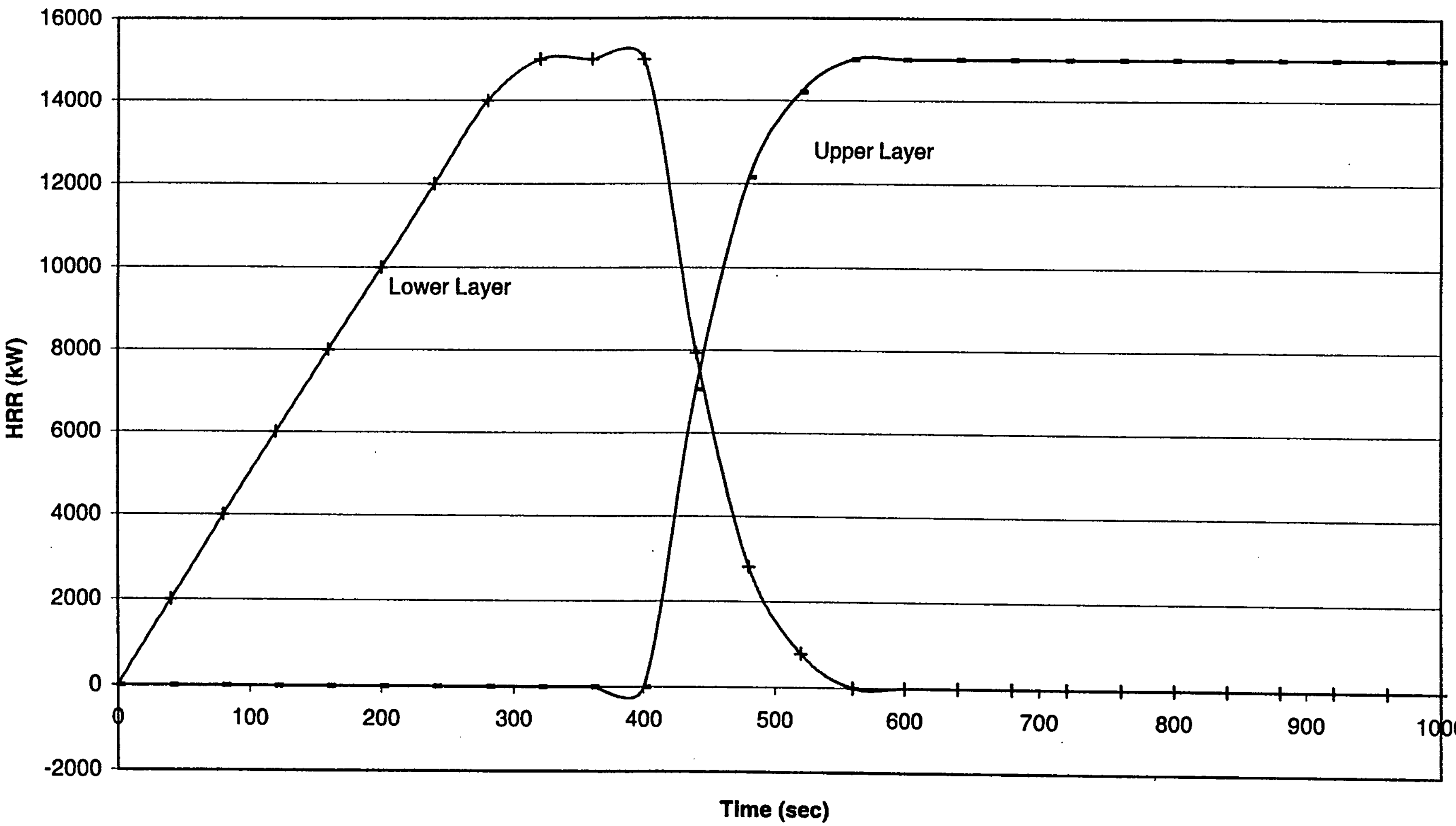


Upper Layer Temperature
Well Deck fire
LCAC reversed (exhaust), FS AS mechanical ventilation, stern gates closed
250
200
150
100
50
0
Temp (deg C)
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)
Well Deck
UVS/MVS

Layer Height
Well Deck fire
LCAC reversed (exhaust), FS AS mechanical ventilation, stern gates closed



HRR, Well Deck
Well Deck fire
LCAC reversed (exhaust), FS AS mechanical ventilation, stern gates closed



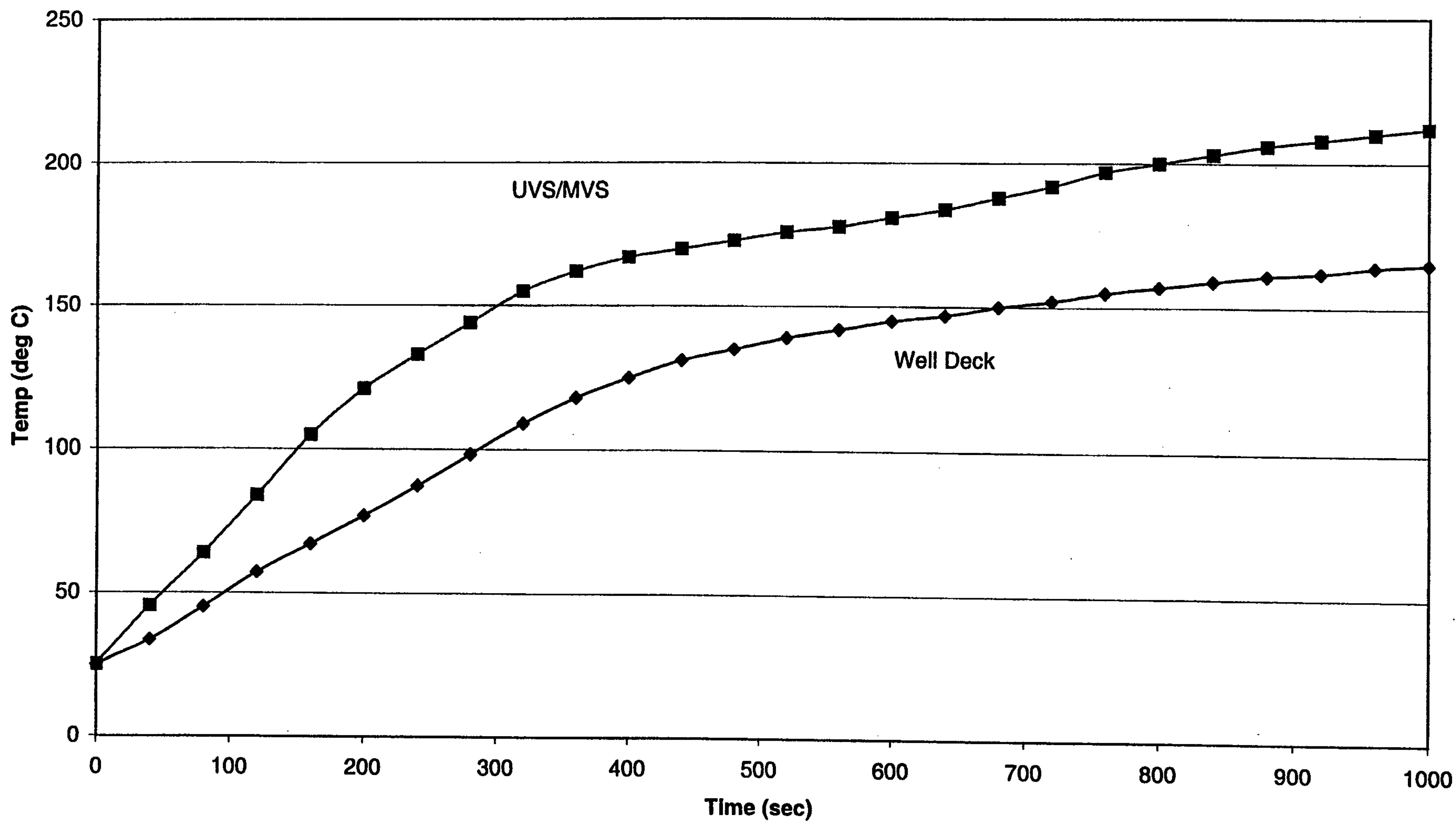
File: lpd17b.in
TSG: closed
BSG: closed
Fire Location: MVSA

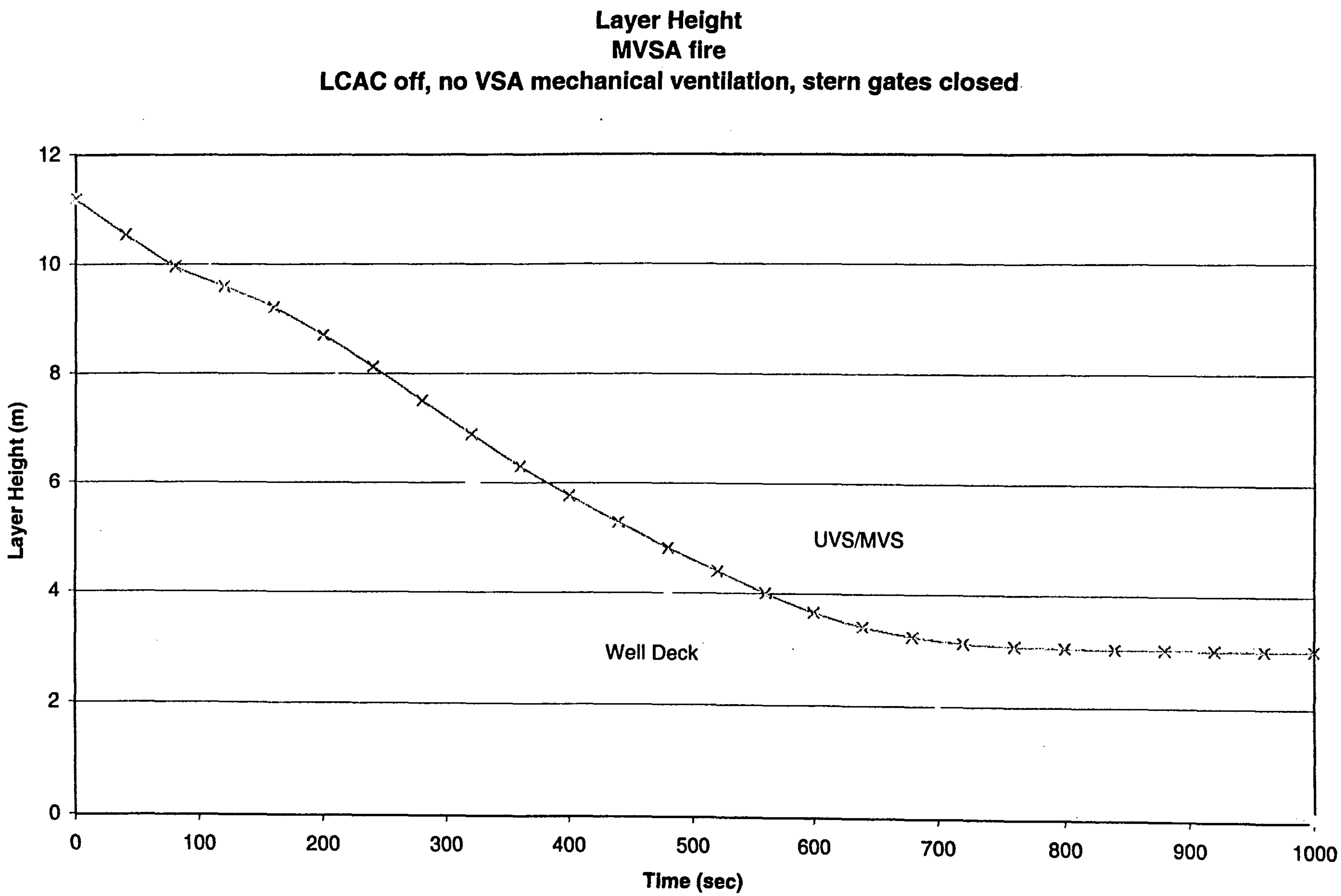
LCAC: off
Fans: no ventilation
Opening: 1' x 1'

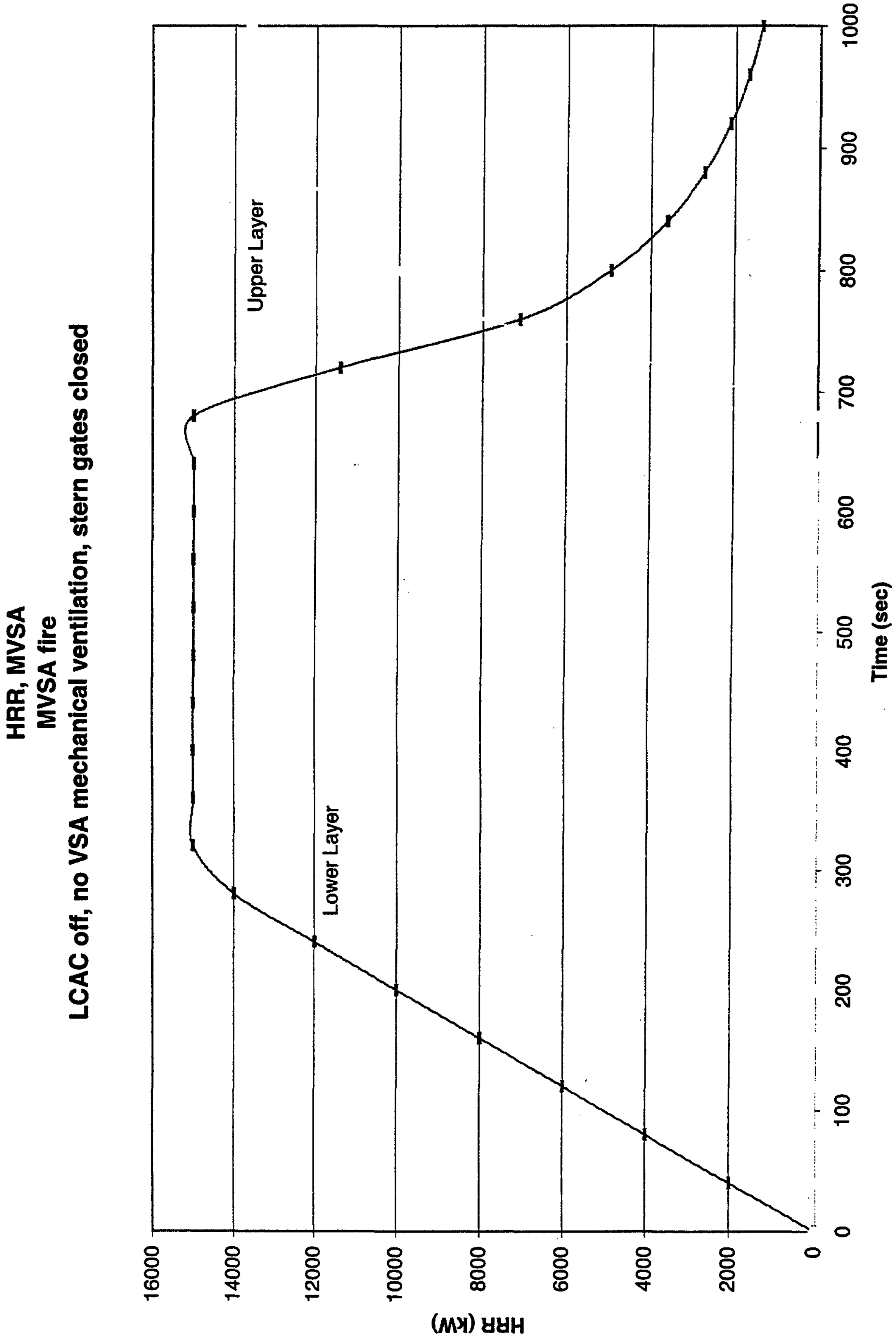
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	33.6	45.5	11.1	10.54	20.4	20.3	0	2000	0	7.459E-14
80	45.1	64	10.6	9.96	20.2	20	0	4000	0	7.459E-14
120	57.3	84.3	9.74	9.6	20.1	19.7	0	6000	0	5.967E-13
160	67.2	105	8.9	9.22	19.9	19.4	0	7999	0	5.967E-13
200	77.2	121	8.19	8.71	19.7	19.2	0	9999	0	1.193E-12
240	87.7	133	7.48	8.13	19.5	19	0	12000	0	1.193E-12
280	98.4	144	6.78	7.5	19.3	18.8	0	14000	0	1.193E-12
320	109	155	6.1	6.88	19.1	18.6	0	15000	0	1.193E-12
360	118	162	5.5	6.3	18.9	18.4	0	15000	0	1.193E-12
400	125	167	4.97	5.77	18.7	18.3	0	15000	0	1.193E-12
440	131	170	4.48	5.28	18.6	18.2	0	14990	0	1.193E-12
480	135	173	4.02	4.82	18.4	18	0	14990	0	1.193E-12
520	139	176	3.59	4.4	18.3	17.9	0	14990	0	1.193E-12
560	142	178	3.2	4.01	18.1	17.7	0	14990	0	1.193E-12
600	145	181	2.85	3.658	18	17.6	0	14990	0	1.193E-12
640	147	184	2.51	3.403	17.8	17.4	0	14990	0	1.193E-12
680	150	188	2.17	3.231	17.7	17.2	0	14990	0	1.193E-12
720	152	192	1.84	3.124	17.5	17	0	11410	0	3581
760	155	197	1.52	3.07459	17.3	16.7	0	7115	0	7876
800	157	200	1.21	3.05014	17.1	16.5	0	4946	0	10040
840	159	203	0.915	3.03656	16.9	16.3	0	3610	0	11380
880	161	206	0.627	3.02851	16.6	16	0	2726	0	12260
920	162	208	0.351	3.02349	16.4	15.8	0	2117	0	12870
960	164	210	0.148	3.02022	16.2	15.5	0	1686	0	13300
1000	165	212	0.06515	3.018	16	15.3	0	1374	0	13610

```
VERSN    3  Scenario 19
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   .30 .30 0.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17b.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
MVSA fire
LCAC off, no VSA mechanical ventilation, stern gates closed



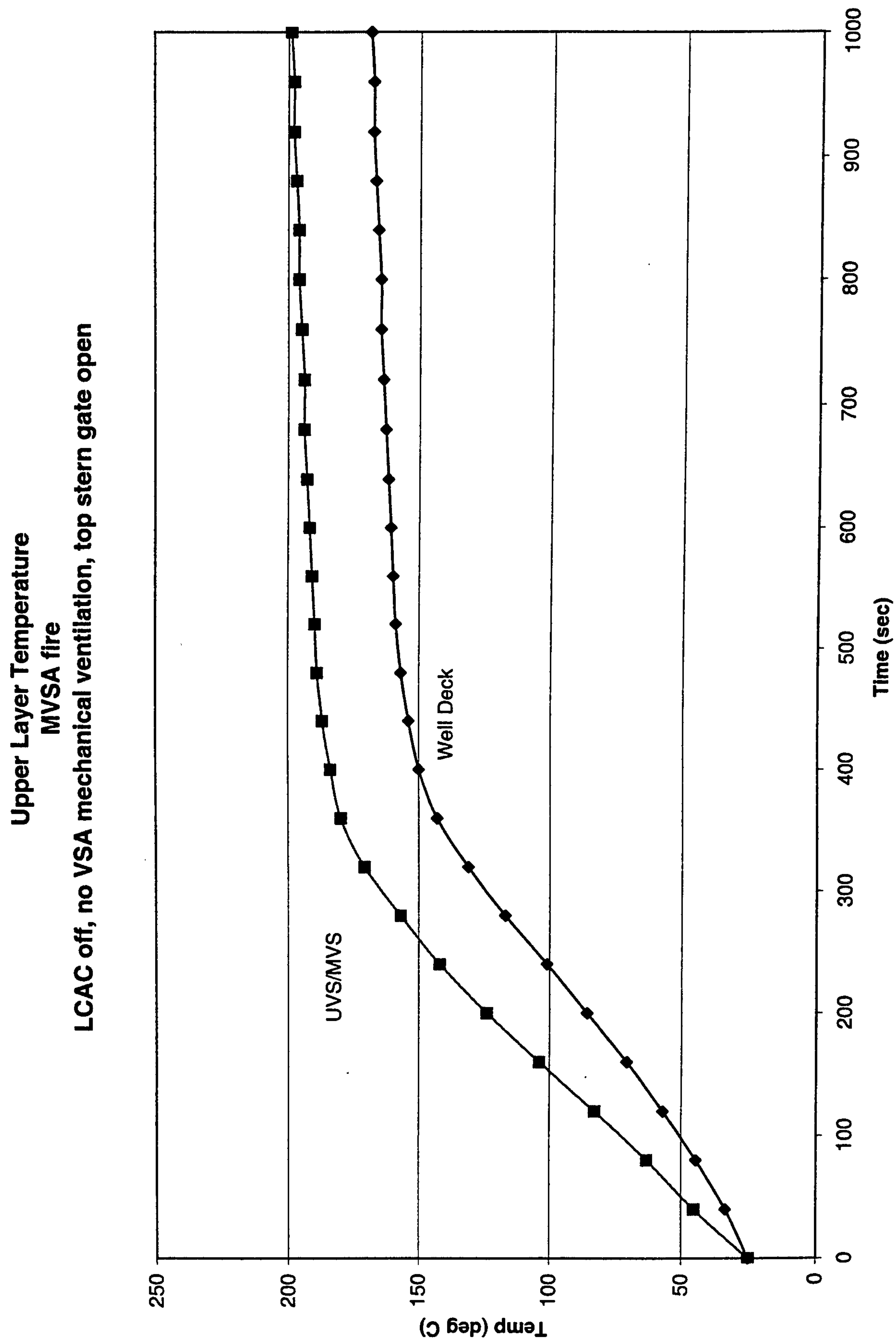

Layer Height
MVSA fire
LCAC off, no VSA mechanical ventilation, stern gates closed
Layer Height (m)
12
10
8
6
4
2
0
UVS/MVS
Well Deck
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)


HRR, MVSA
MVSA fire
LCAC off, no VSA mechanical ventilation, stern gates closed
Upper Layer
Lower Layer
HRR (kW)
Time (sec)
0
2000
4000
6000
8000
10000
12000
14000
16000
100
200
300
400
500
600
700
800
900
1000

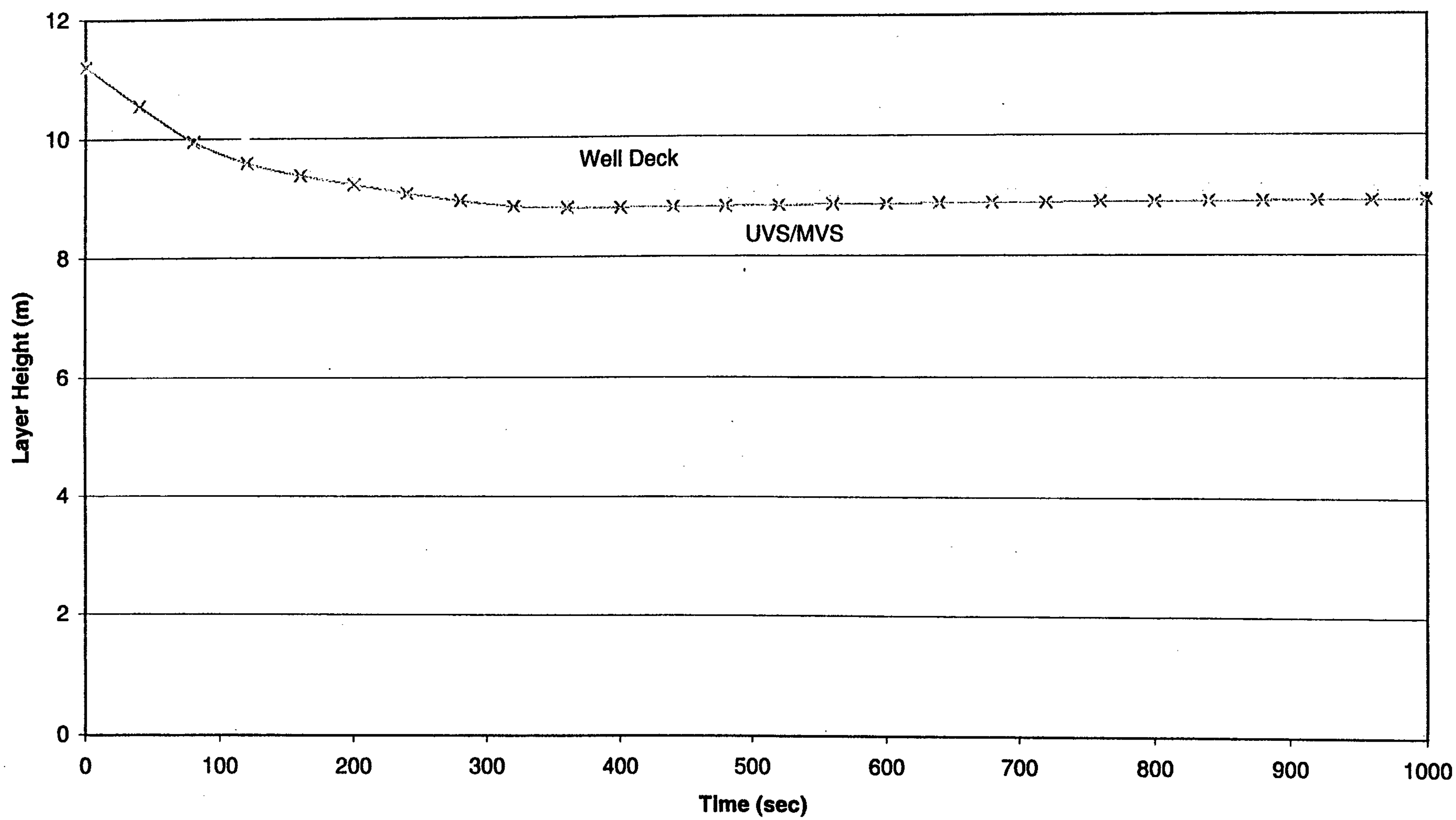
File:	lpd17e.in		
TSG:	open	**LCAC:**	off
BSG:	closed	**Fans:**	no ventilation
Fire Location:	MVSA	**Opening:**	none

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	33.4	45.3	11.1	10.54	20.4	20.3	0	2000	0	7.459E-14
80	44.6	63.3	10.6	9.95	20.2	20	0	4000	0	7.459E-14
120	57.1	83	9.96	9.6	20	19.7	0	6000	0	5.967E-13
160	70.8	104	9.53	9.39	19.8	19.4	0	8000	0	5.967E-13
200	85.8	124	9.32	9.23	19.5	19.1	0	10000	0	1.193E-12
240	101	142	9.2	9.08	19.2	18.8	0	12000	0	1.193E-12
280	117	157	9.11	8.95	18.9	18.5	0	14000	0	1.193E-12
320	131	171	9.04	8.85	18.6	18.3	0	15000	0	1.193E-12
360	143	180	9.03	8.82	18.4	18.2	0	15000	0	1.193E-12
400	150	184	9.05	8.82	18.3	18.1	0	15000	0	1.193E-12
440	154	187	9.07	8.83	18.2	18.1	0	15000	0	1.193E-12
480	157	189	9.08	8.84	18.2	18.1	0	15000	0	1.193E-12
520	159	190	9.1	8.85	18.1	18.1	0	15000	0	1.193E-12
560	160	191	9.11	8.86	18.1	18.1	0	15000	0	1.193E-12
600	161	192	9.11	8.87	18.1	18.1	0	15000	0	1.193E-12
640	162	193	9.12	8.88	18.1	18.1	0	15000	0	1.193E-12
680	163	194	9.12	8.89	18.1	18.1	0	15000	0	1.193E-12
720	164	194	9.13	8.89	18.1	18.1	0	15000	0	1.193E-12
760	165	195	9.13	8.9	18.2	18.1	0	15000	0	1.193E-12
800	165	196	9.13	8.9	18.2	18.1	0	15000	0	1.193E-12
840	166	196	9.14	8.91	18.2	18.1	0	15000	0	1.193E-12
880	167	197	9.14	8.91	18.2	18.1	0	15000	0	1.193E-12
920	168	198	9.14	8.92	18.2	18.1	0	15000	0	1.193E-12
960	168	198	9.14	8.92	18.2	18.1	0	15000	0	1.193E-12
1000	169	199	9.15	8.93	18.2	18.1	0	15000	0	1.193E-12

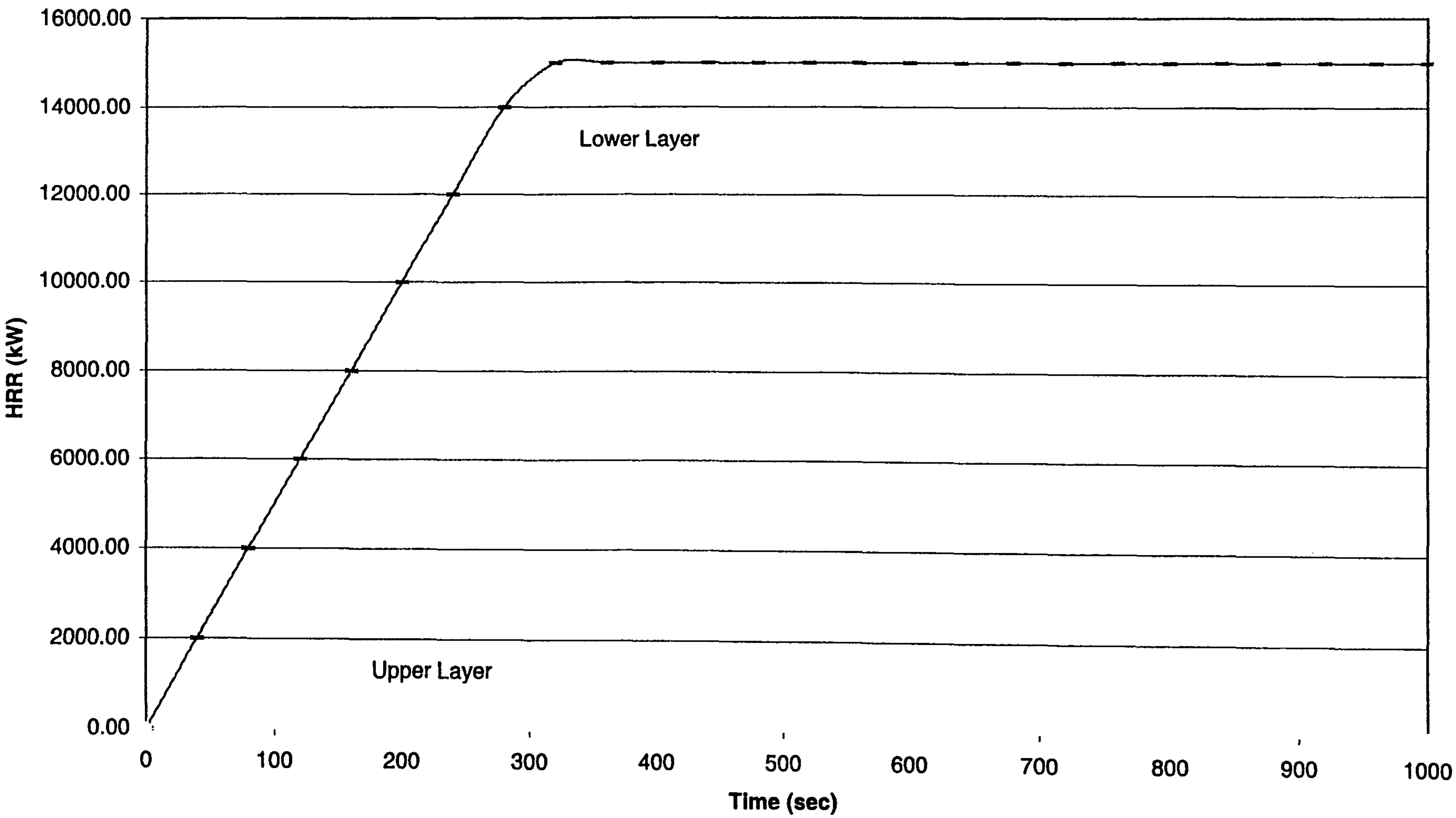
```
VERSN    3  Scenario 20
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   18.5 11.0  6.8
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD     .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17e.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER    0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```


Upper Layer Temperature
MVSA fire
LCAC off, no VSA mechanical ventilation, top stern gate open
UVS/MVS
Well Deck
Temp (deg C)
Time (sec)
0
50
100
150
200
250
0
100
200
300
400
500
600
700
800
900
1000

Layer Height
MVSA Fire
LCAC off, no VSA mechanical ventilation, top stern gate open



HRR, MVSA/UVSA
MVSA Fire
LCAC off, no VSA mechanical ventilation, top stern gate open



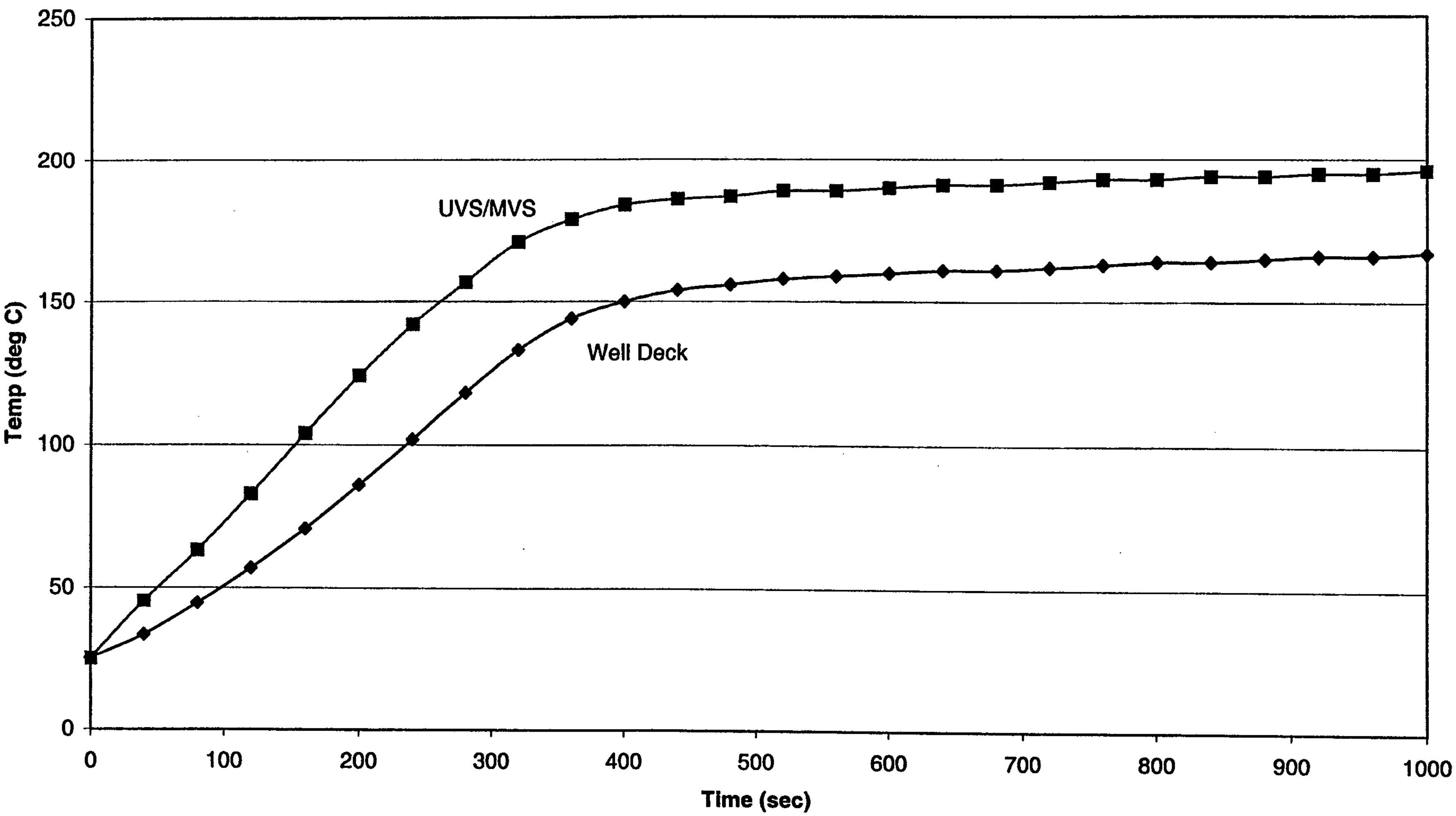
File: lpd17h.in
TSG: open
BSG: open
Fire Location: MVSA

LCAC: off
Fans: no ventilation
Opening: none

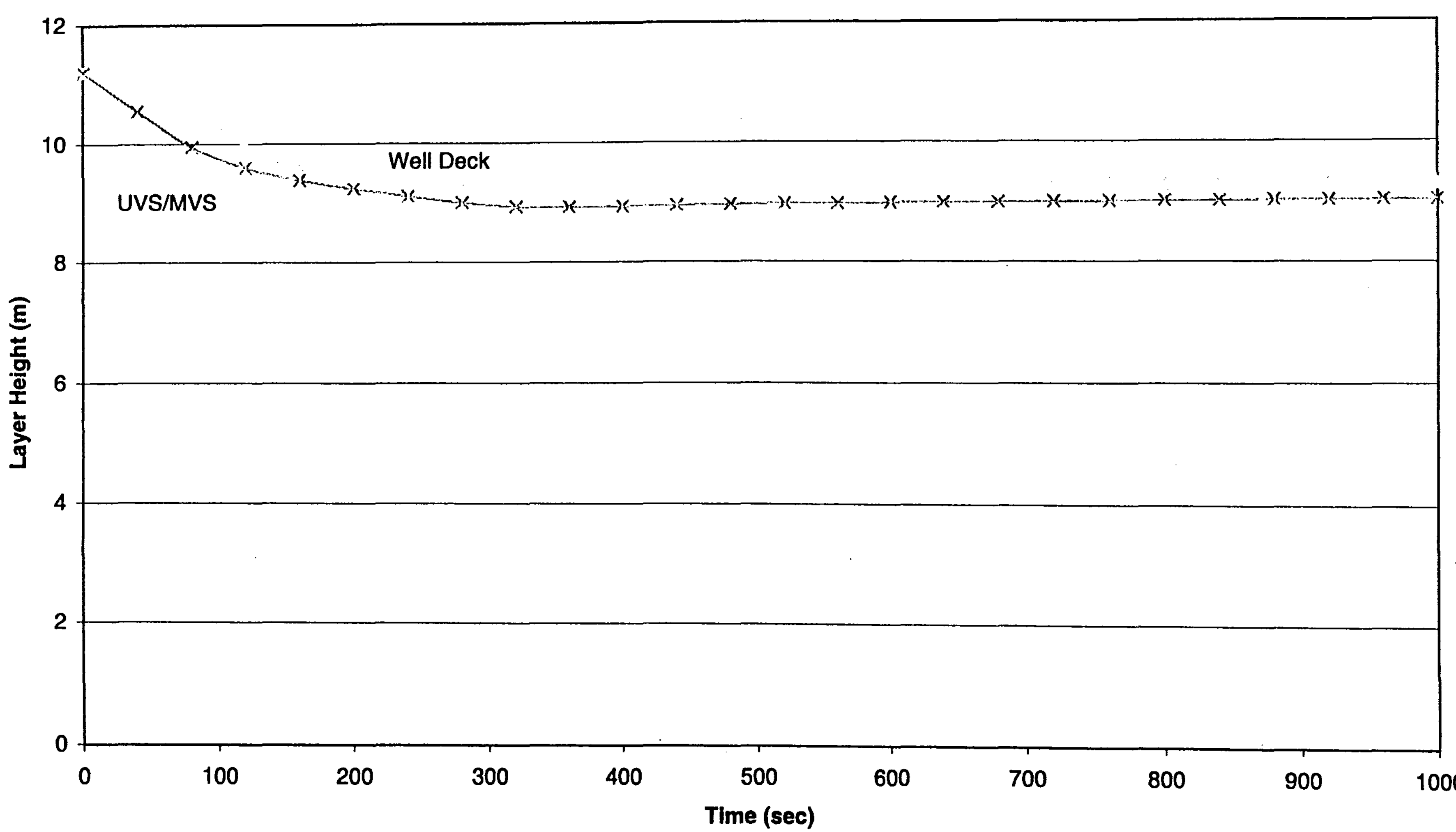
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	33.4	45.3	11.1	10.54	20.4	20.3	0	2000	0	3.73E-14
80	44.6	63.3	10.6	9.95	20.2	20	0	4000	0	3.73E-14
120	57.1	83	9.96	9.6	20	19.7	0	6000	0	5.967E-13
160	70.8	104	9.55	9.39	19.8	19.4	0	8000	0	5.967E-13
200	86.2	124	9.37	9.24	19.5	19.1	0	10000	0	1.193E-12
240	102	142	9.28	9.11	19.2	18.8	0	12000	0	1.193E-12
280	118	157	9.22	9	18.9	18.5	0	14000	0	1.193E-12
320	133	171	9.18	8.93	18.6	18.3	0	15000	0	1.193E-12
360	144	179	9.19	8.92	18.4	18.2	0	15000	0	1.193E-12
400	150	184	9.21	8.93	18.3	18.2	0	15000	0	1.193E-12
440	154	186	9.23	8.94	18.2	18.2	0	15000	0	1.193E-12
480	156	187	9.25	8.96	18.2	18.2	0	15000	0	1.193E-12
520	158	189	9.25	8.97	18.2	18.2	0	15000	0	1.193E-12
560	159	189	9.26	8.97	18.2	18.2	0	15000	0	1.193E-12
600	160	190	9.27	8.98	18.2	18.2	0	15000	0	1.193E-12
640	161	191	9.27	8.99	18.2	18.2	0	15000	0	1.193E-12
680	161	191	9.27	8.99	18.2	18.2	0	15000	0	1.193E-12
720	162	192	9.28	9	18.2	18.2	0	15000	0	1.193E-12
760	163	193	9.28	9	18.2	18.2	0	15000	0	1.193E-12
800	164	193	9.28	9.01	18.2	18.2	0	15000	0	1.193E-12
840	164	194	9.29	9.01	18.3	18.2	0	15000	0	1.193E-12
880	165	194	9.29	9.02	18.3	18.2	0	15000	0	1.193E-12
920	166	195	9.29	9.02	18.3	18.2	0	15000	0	1.193E-12
960	166	195	9.3	9.03	18.3	18.2	0	15000	0	1.193E-12
1000	167	196	9.3	9.03	18.3	18.2	0	15000	0	1.193E-12

```
VERSN    3  Scenario 21
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   18.5 11.0  0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170 50. 10 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17h.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1    1 U
TEMPERA 0 0 0 0 2    1 U
TEMPERA 0 0 0 0 2    1 L
TEMPERA 0 0 0 0 2    2 L
```

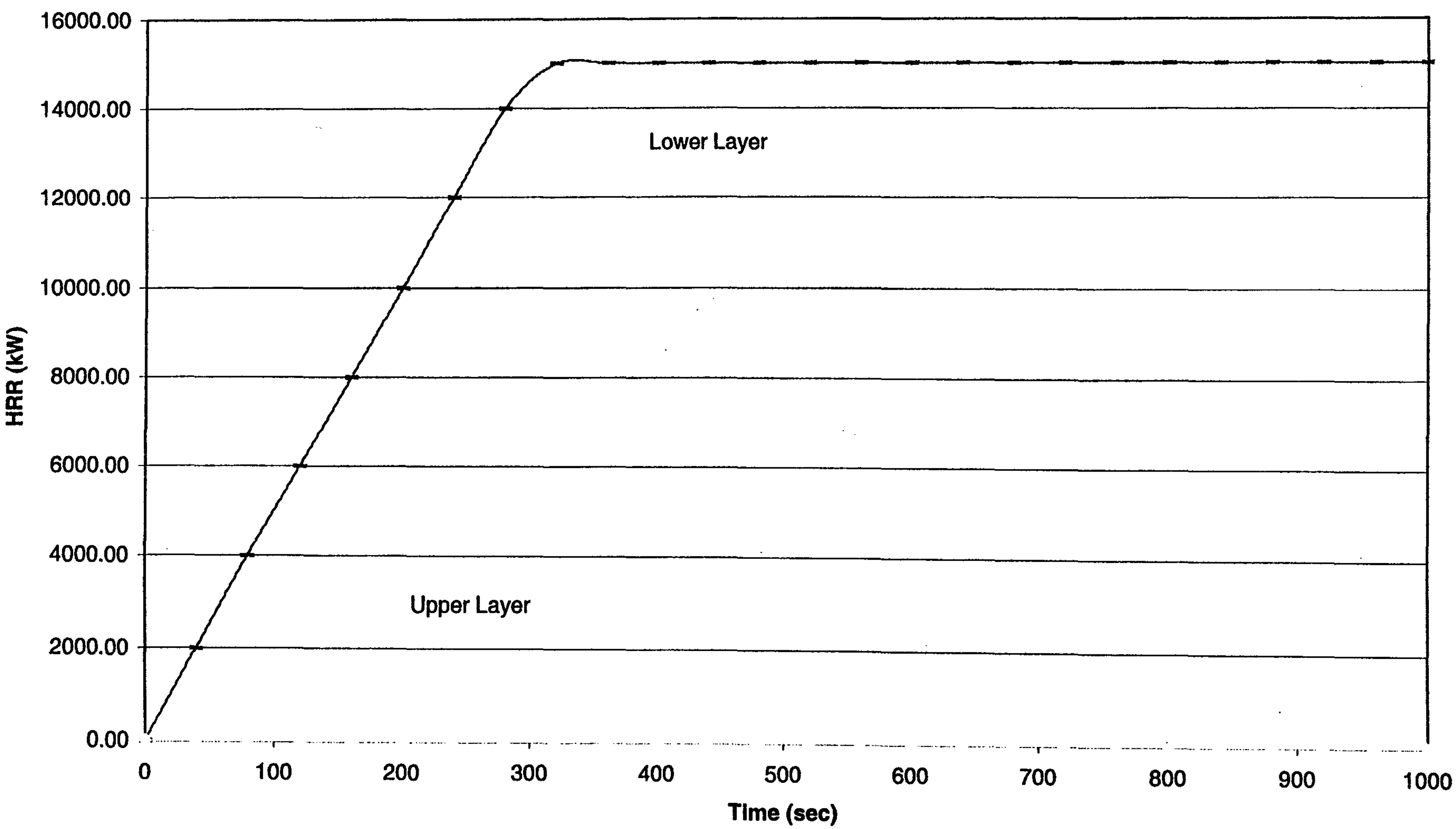
Upper Layer Temperature
MVSA Fire
LCAC off, no VSA mechanical ventilation, stern gates open



Layer Height
MVSA Fire
LCAC off, no VSA mechanical ventilation, stern gates open



HRR, UVSA/MVSA
MVSA Fire
LCAC off, no VSA mechanical ventilation, stern gates open



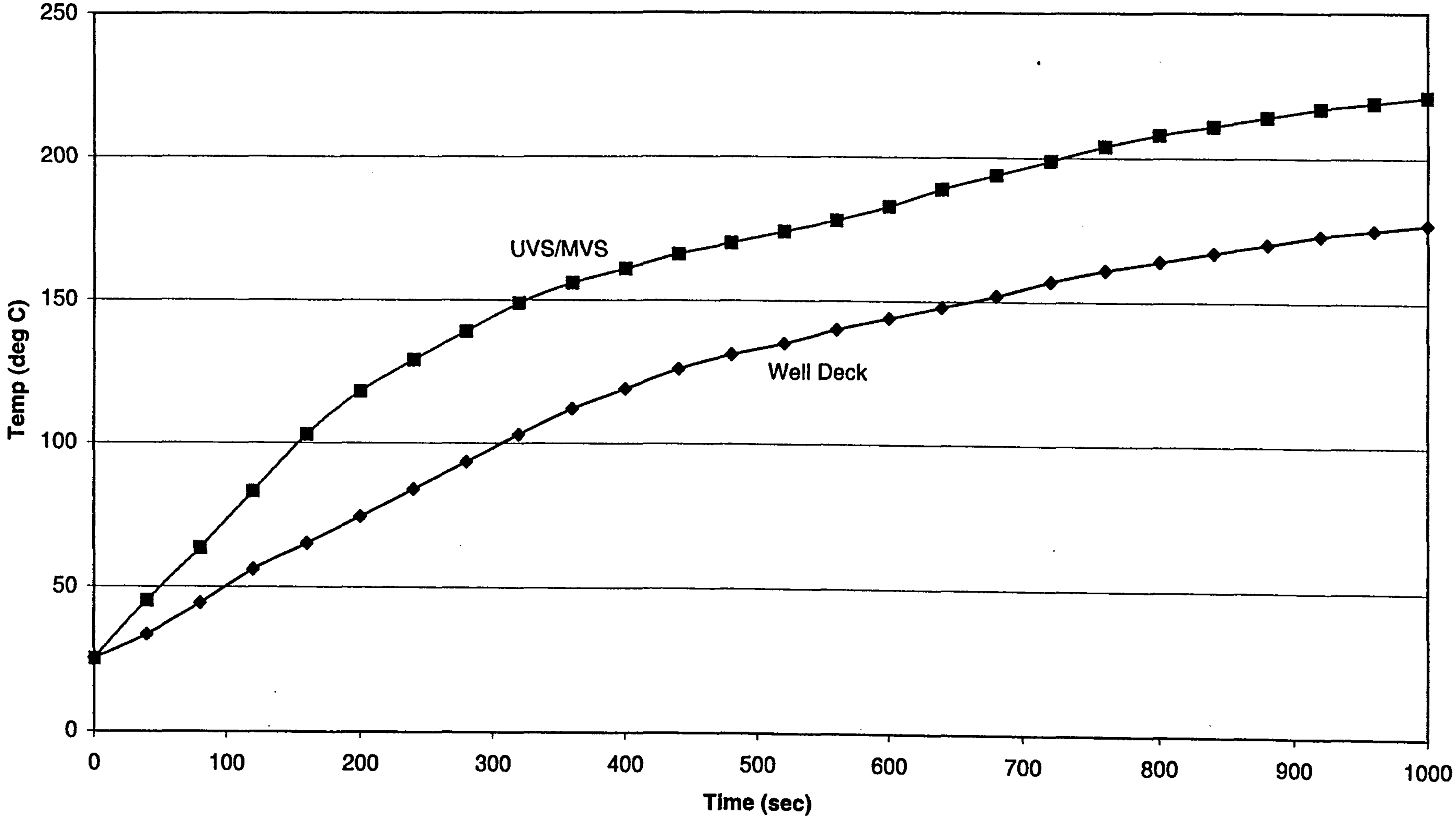
File: lpd17k.in
TSG: closed
BSG: closed
Fire Location well deck MVSA

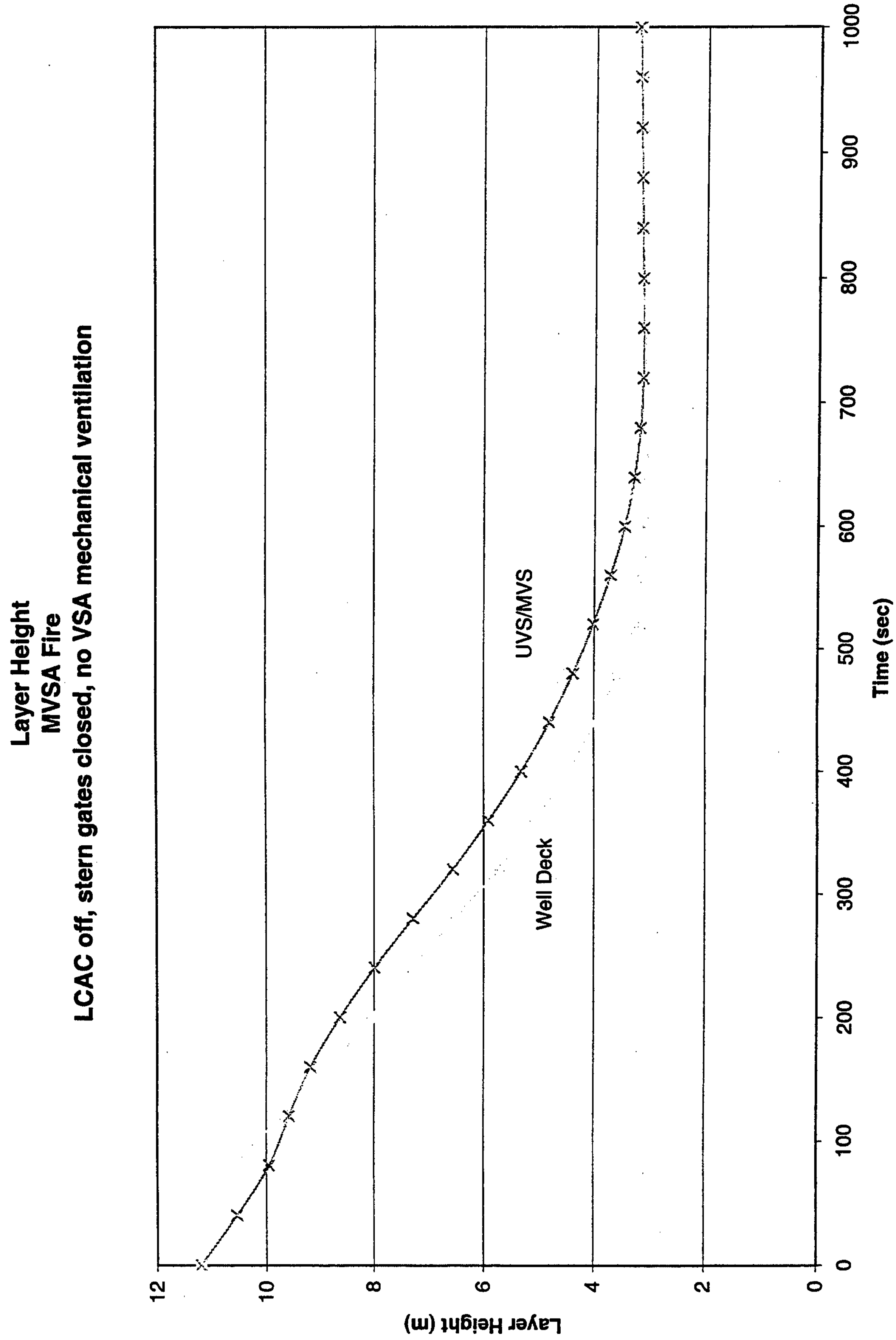
LCAC: off
Fans: no ventilation
Opening: 2.8 x 5.0

Time (sec)	Upper Layer Temp (deg C) Comp. 1	Upper Layer Temp (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRF (kW) Comp. 1	Lower Layer HRF (kW) Comp. 2	Upper Layer HRF (kW) Comp. 1	Upper Layer HRI (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	33.4	45.3	11.1	10.54	20.4	20.3	0	2000	0	7.459E-14
80	44.5	63.3	10.6	9.95	20.2	20	0	4000	0	2.984E-13
120	56	83	9.71	9.58	20.1	19.7	0	6000	0	2.984E-13
160	65	103	8.84	9.18	19.9	19.4	0	8000	0	2.984E-13
200	74.2	118	8.08	8.63	19.7	19.2	0	10000	0	1.193E-12
240	83.8	129	7.31	7.99	19.5	19	0	12000	0	1.193E-12
280	93.5	139	6.52	7.29	19.3	18.8	0	14000	0	1.193E-12
320	103	149	5.73	6.57	19.1	18.6	0	15000	0	1.193E-12
360	112	156	5.05	5.91	18.9	18.4	0	15000	0	1.193E-12
400	119	161	4.46	5.31	18.7	18.2	0	15000	0	1.193E-12
440	126	166	3.98	4.8	18.5	18.1	0	15000	0	1.193E-12
480	131	170	3.58	4.38	18.3	17.9	0	15000	0	1.193E-12
520	135	174	3.3	4.02	18.2	17.7	0	15000	0	1.193E-12
560	140	178	3.13	3.711	18	17.6	0	15000	0	1.193E-12
600	144	183	3.06	3.465	17.8	17.4	0	15000	0	1.193E-12
640	148	189	3.06	3.292	17.6	17.1	0	14990	0	1.193E-12
680	152	194	3.07	3.189	17.4	16.9	0	14990	0	1.193E-12
720	157	199	3.1	3.143	17.2	16.6	0	13540	0	1456
760	161	204	3.12	3.138	16.9	16.4	0	13190	0	1805
800	164	208	3.14	3.147	16.7	16.1	0	14060	0	936
840	167	211	3.15	3.159	16.4	15.9	0	14990	0	18.8
880	170	214	3.16	3.173	16.2	15.6	0	14990	0	18.8
920	173	217	3.17	3.19	15.9	15.4	0	14990	0	18.8
960	175	219	3.18	3.205	15.7	15.2	0	14990	0	18.8
1000	177	221	3.19	3.22	15.5	15	0	14990	0	18.8

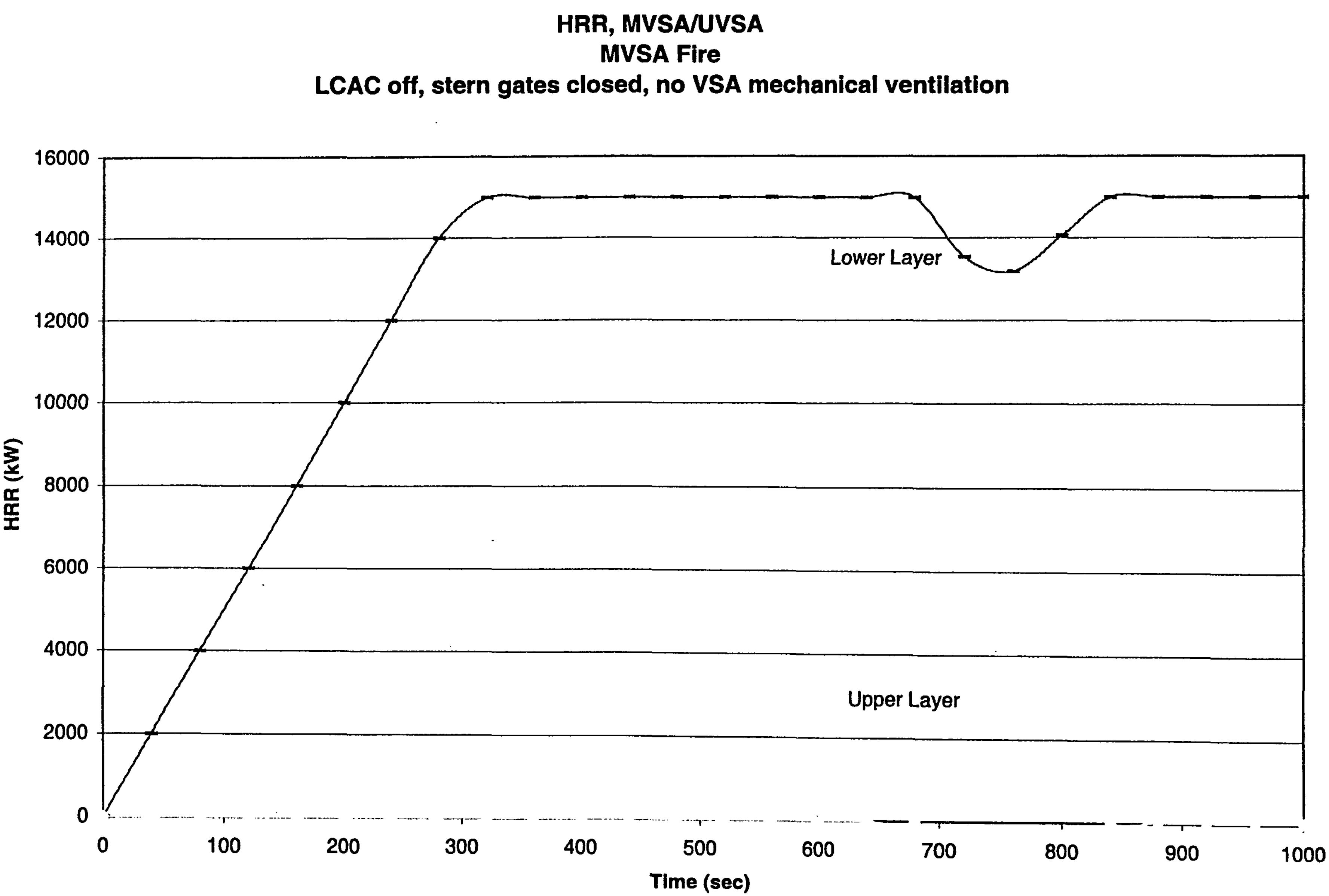
```
VERSN     3  Scenario 22
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17k.hi
DEVICE 1
WINDOW       0      0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER    0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
MVSA fire
LCAC off, stern gates closed, no VSA mechanical ventilation





Layer Height
MVSA Fire
LCAC off, stern gates closed, no VSA mechanical ventilation
UVS/MVS
Well Deck
Layer Height (m)
Time (sec)
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000

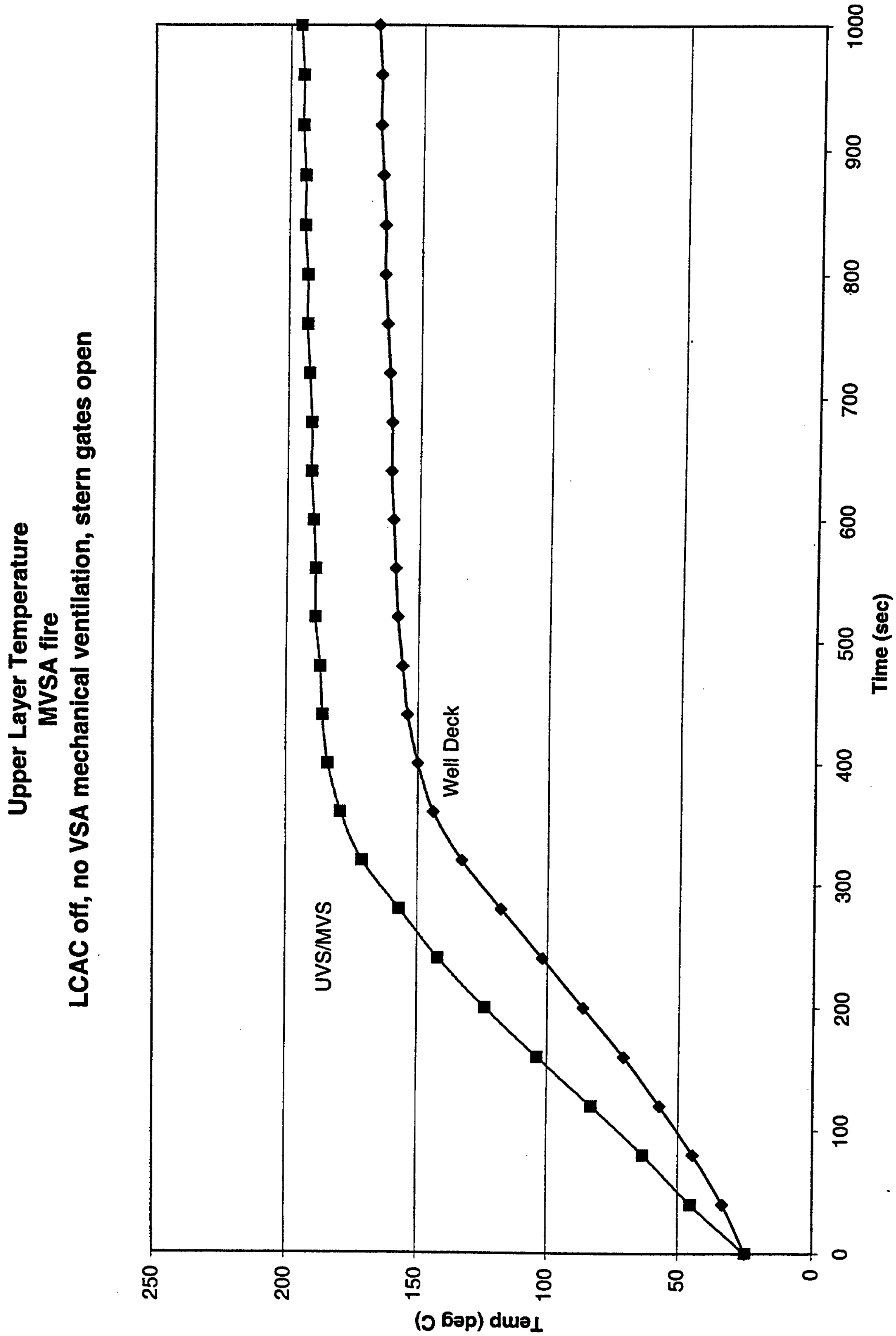

HRR, MVSA/UVSA
MVSA Fire
LCAC off, stern gates closed, no VSA mechanical ventilation
16000
14000
12000
10000
8000
6000
4000
2000
0
HRR (kW)
Lower Layer
Upper Layer
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)

File: lpd17n.in
TSG: open
BSG: open
Fire Location MVSA

LCAC: off
Fans: no ventilation
Opening: 2.8 x 5.0

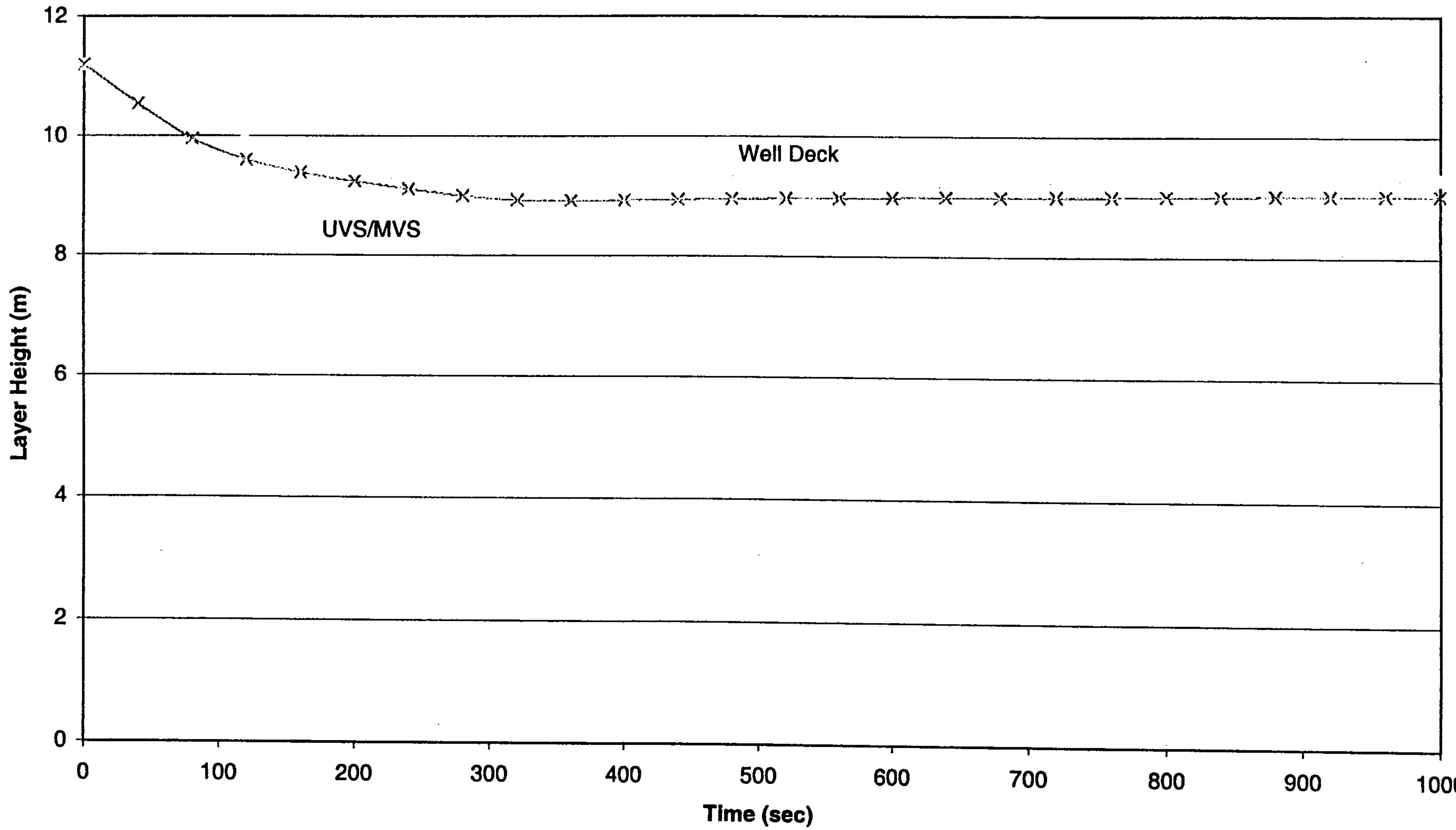
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	33.4	45.3	11.1	10.54	20.4	20.3	0	2000	0	1.492E-13
80	44.6	63.3	10.6	9.95	20.2	20	0	4000	0	2.984E-13
120	57.1	83	9.96	9.6	20	19.7	0	6000	0	5.967E-13
160	70.8	104	9.55	9.39	19.8	19.4	0	8000	0	5.967E-13
200	86.2	124	9.37	9.24	19.5	19.1	0	10000	0	1.193E-12
240	102	142	9.28	9.11	19.2	18.8	0	12000	0	1.193E-12
280	118	157	9.23	9	18.9	18.5	0	14000	0	1.193E-12
320	133	171	9.18	8.93	18.6	18.3	0	15000	0	1.193E-12
360	144	179	9.19	8.92	18.4	18.2	0	15000	0	1.193E-12
400	150	184	9.22	8.93	18.3	18.2	0	15000	0	1.193E-12
440	154	186	9.23	8.94	18.2	18.2	0	15000	0	1.193E-12
480	156	187	9.25	8.96	18.2	18.2	0	15000	0	1.193E-12
520	158	189	9.26	8.97	18.2	18.2	0	15000	0	1.193E-12
560	159	189	9.26	8.97	18.2	18.2	0	15000	0	1.193E-12
600	160	190	9.27	8.98	18.2	18.2	0	15000	0	1.193E-12
640	161	191	9.27	8.99	18.2	18.2	0	15000	0	1.193E-12
680	161	191	9.27	8.99	18.2	18.2	0	15000	0	1.193E-12
720	162	192	9.28	9	18.2	18.2	0	15000	0	1.193E-12
760	163	193	9.28	9	18.2	18.2	0	15000	0	1.193E-12
800	164	193	9.29	9.01	18.2	18.2	0	15000	0	1.193E-12
840	164	194	9.29	9.01	18.3	18.2	0	15000	0	1.193E-12
880	165	194	9.29	9.02	18.3	18.2	0	15000	0	1.193E-12
920	166	195	9.3	9.02	18.3	18.2	0	15000	0	1.193E-12
960	166	195	9.3	9.03	18.3	18.2	0	15000	0	1.193E-12
1000	167	196	9.3	9.03	18.3	18.2	0	15000	0	1.193E-12

```
VERSN    3  Scenario 23
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   18.5 11.0  0
HVENT  1  3  2   2.8  5.0  0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17n.hi
DEVICE 1
WINDOW        0      0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

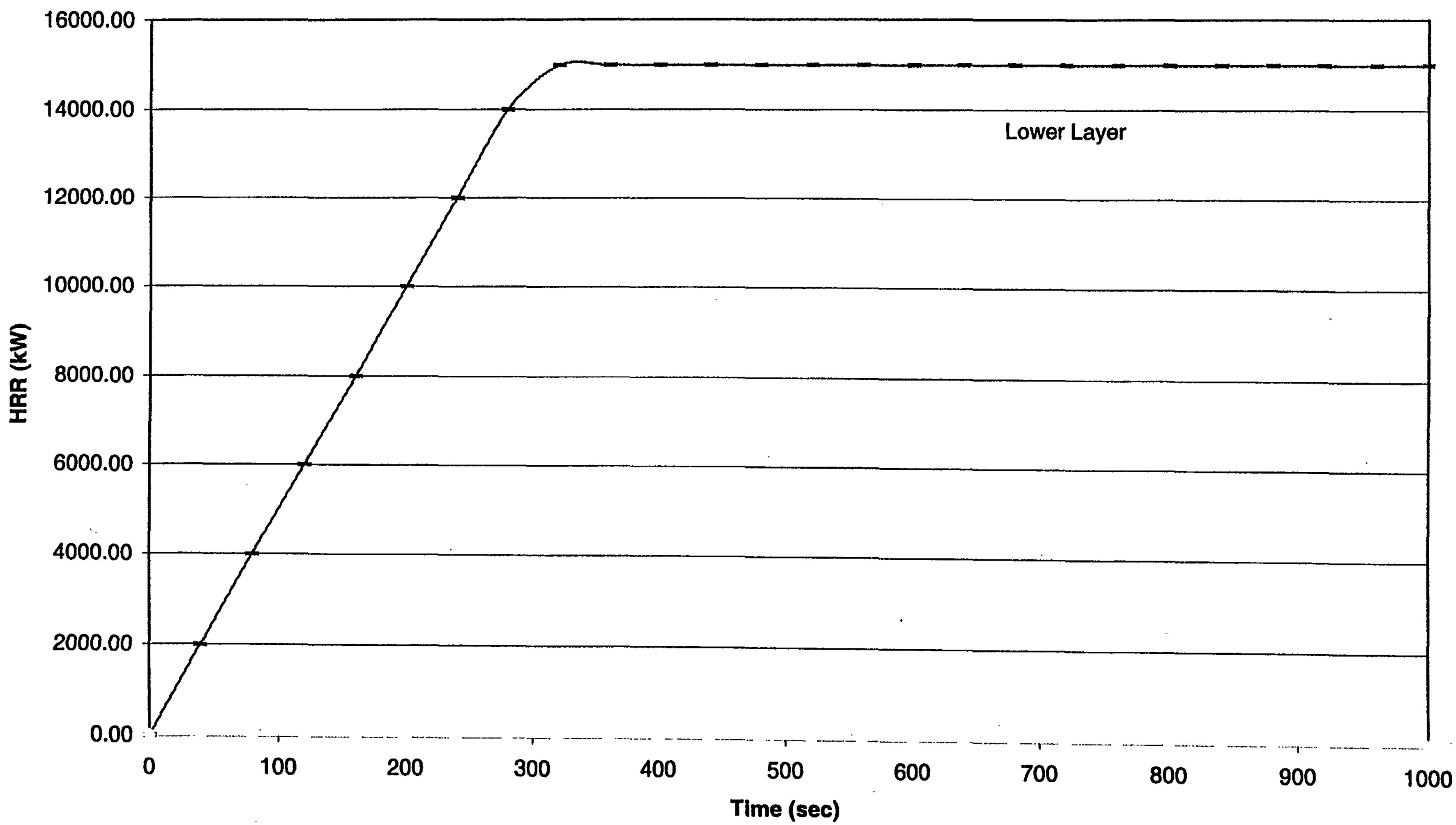


Upper Layer Temperature
MVSA fire
LCAC off, no VSA mechanical ventilation, stern gates open
UVS/MVS
Well Deck
Temp (deg C)
Time (sec)
0
50
100
150
200
250
0
100
200
300
400
500
600
700
800
900
1000

Layer Height
MVSA fire
LCAC off, no VSA mechanical ventilation, stern gates open



HRR, UVSA/MVSA
MVSA fire
LCAC off, no VSA mechanical ventilation, stern gates open



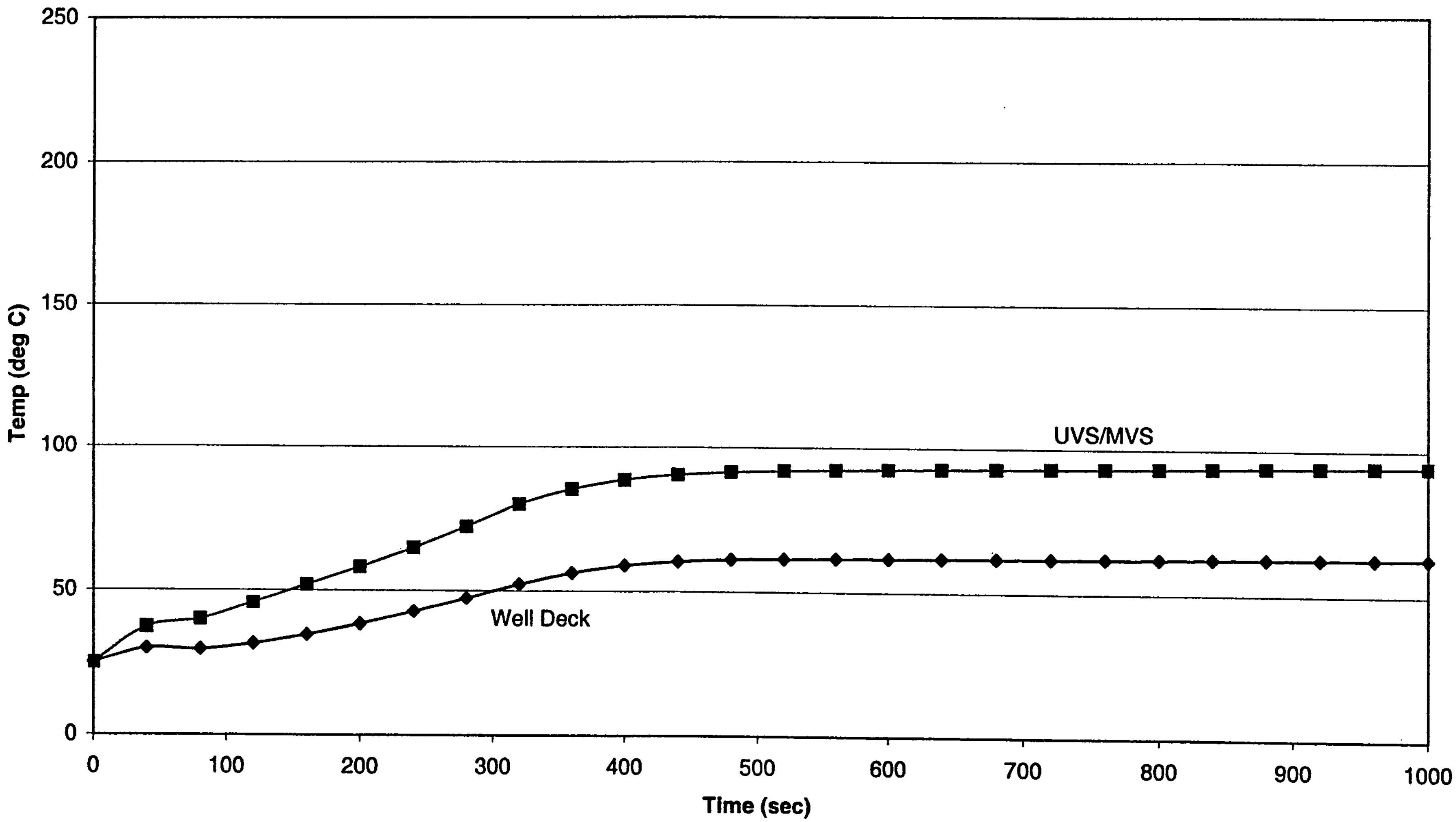
File: lpd17mmm.in
TSG: closed
BSG: closed) see plots
Fire Location: MVSA

LCAC: supply
Fans: no ventilation
Opening: 2.8 x 5.0

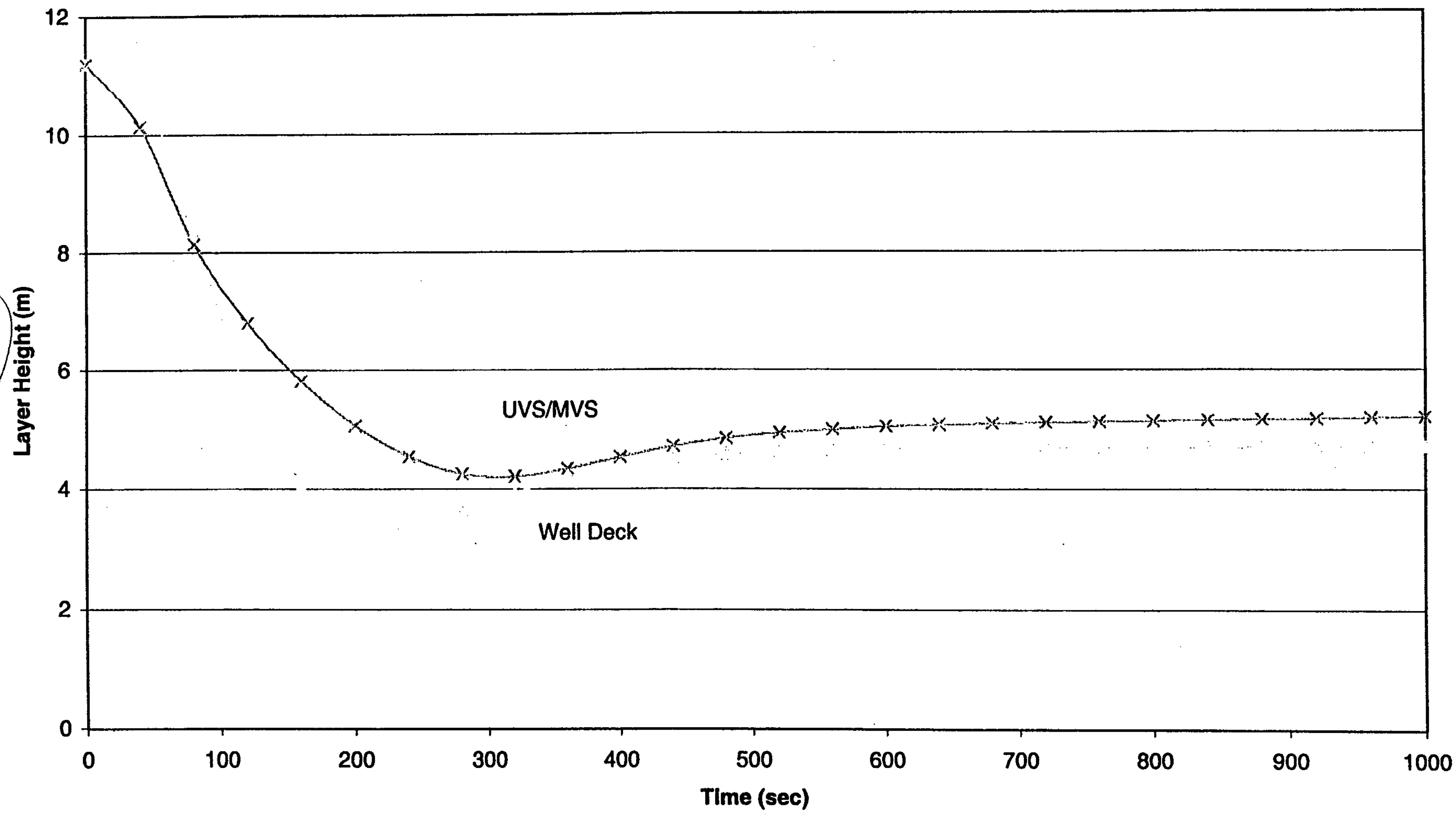
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	29.8	37.2	10.9	10.14	20.4	20.3	0	2000	0	0
80	29.6	40	8.3	8.14	20.4	20.2	0	4000	0	0
120	31.5	45.8	5.58	6.78	20.3	20.2	0	6000	0	0
160	34.6	52	4.04	5.81	20.3	20.1	0	8000	0	0
200	38.4	58.2	3.4	5.06	20.2	20	0	10000	0	0
240	42.7	64.8	3.38	4.54	20.2	19.9	0	12000	0	0
280	47.4	72.2	3.65	4.25	20.1	19.8	0	14000	0	0
320	52.3	80.1	3.94	4.21	20	19.7	0	15000	0	0
360	56.3	85.4	4.21	4.34	20	19.6	0	15000	0	0
400	58.9	88.6	4.39	4.53	20	19.6	0	15000	0	0
440	60.4	90.4	4.52	4.71	19.9	19.6	0	15000	0	0
480	61.1	91.4	4.59	4.85	19.9	19.6	0	15000	0	0
520	61.4	92	4.63	4.94	19.9	19.6	0	15000	0	0
560	61.6	92.3	4.66	5	19.9	19.6	0	15000	0	0
600	61.7	92.5	4.67	5.05	19.9	19.6	0	15000	0	0
640	61.8	92.7	4.68	5.08	19.9	19.6	0	15000	0	0
680	61.9	92.9	4.69	5.1	19.9	19.6	0	15000	0	0
720	62	93.1	4.69	5.12	19.9	19.6	0	15000	0	0
760	62.1	93.2	4.7	5.13	19.9	19.6	0	15000	0	0
800	62.2	93.4	4.7	5.14	19.9	19.6	0	15000	0	0
840	62.3	93.6	4.7	5.16	19.9	19.6	0	15000	0	0
880	62.4	93.8	4.71	5.17	19.9	19.6	0	15000	0	0
920	62.5	94	4.71	5.18	19.9	19.6	0	15000	0	0
960	62.6	94.2	4.71	5.2	19.9	19.6	0	15000	0	0
1000	62.7	94.3	4.71	5.21	19.9	19.6	0	15000	0	0

```
VERSN    3   Scenario 24
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.2  0.0
MVOPN  2  1 V   8.2  4.0
MVOPN  3  4 V  8.2  4.0
MVOPN  1  5 V  11.2  4.0
MVOPN  3  8 V  11.2  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2  0.0  1000. 90
MVFAN  7  6   0.0  1000. 90
INELV    1   11.2  2   11.2  3  11.2  4   11.2
INELV    5   11.2  6   11.2  7  11.2  8   11.2
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR 1pd17mmm.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

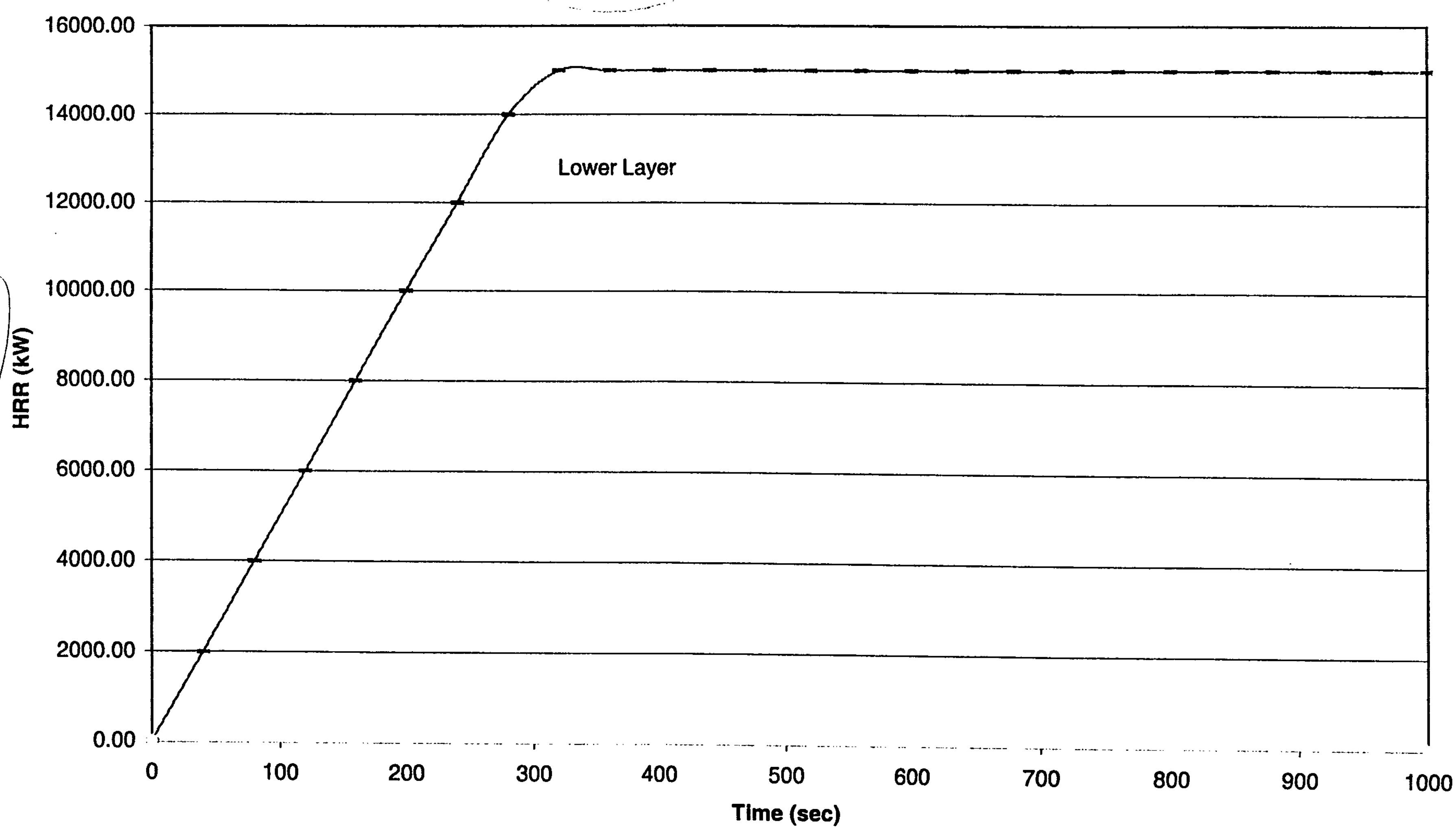
Upper Layer Temperature
MVSA fire
LCAC supply, stern gates open, no VSA mechanical ventilation



Layer Height
MVSA fire
LCAC supply, stern gates open, no VSA mechanical ventilation



HRR, MVSA/UVSA
MVSA fire
LCAC supply, stern gates open, no VSA mechanical ventilation



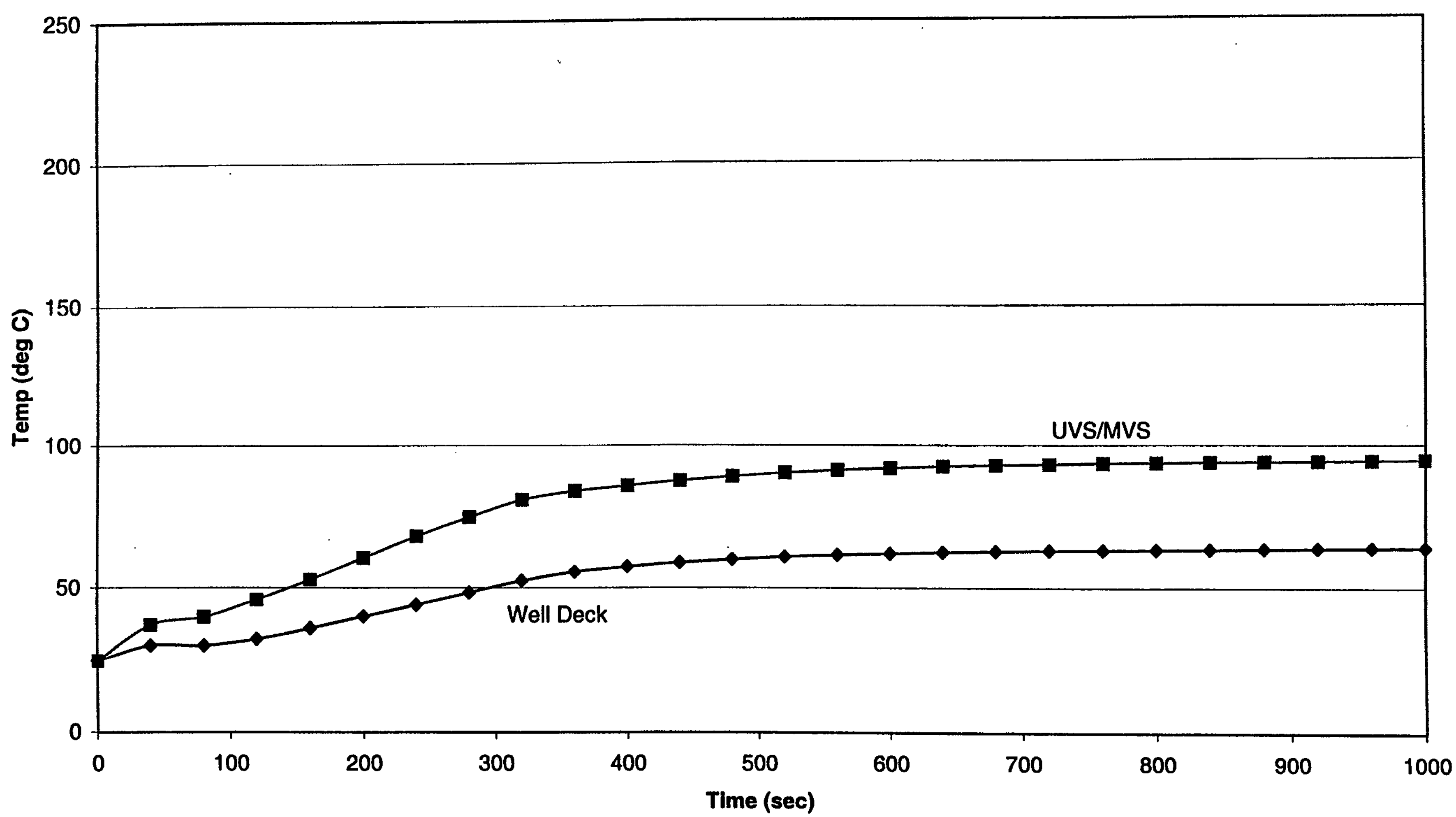
File: lpd17nnn.in
TSG: open
BSG: closed
Fire Location: MVSA

LCAC: supply
Fans: no ventilation
Opening: 2.8 x 5.0

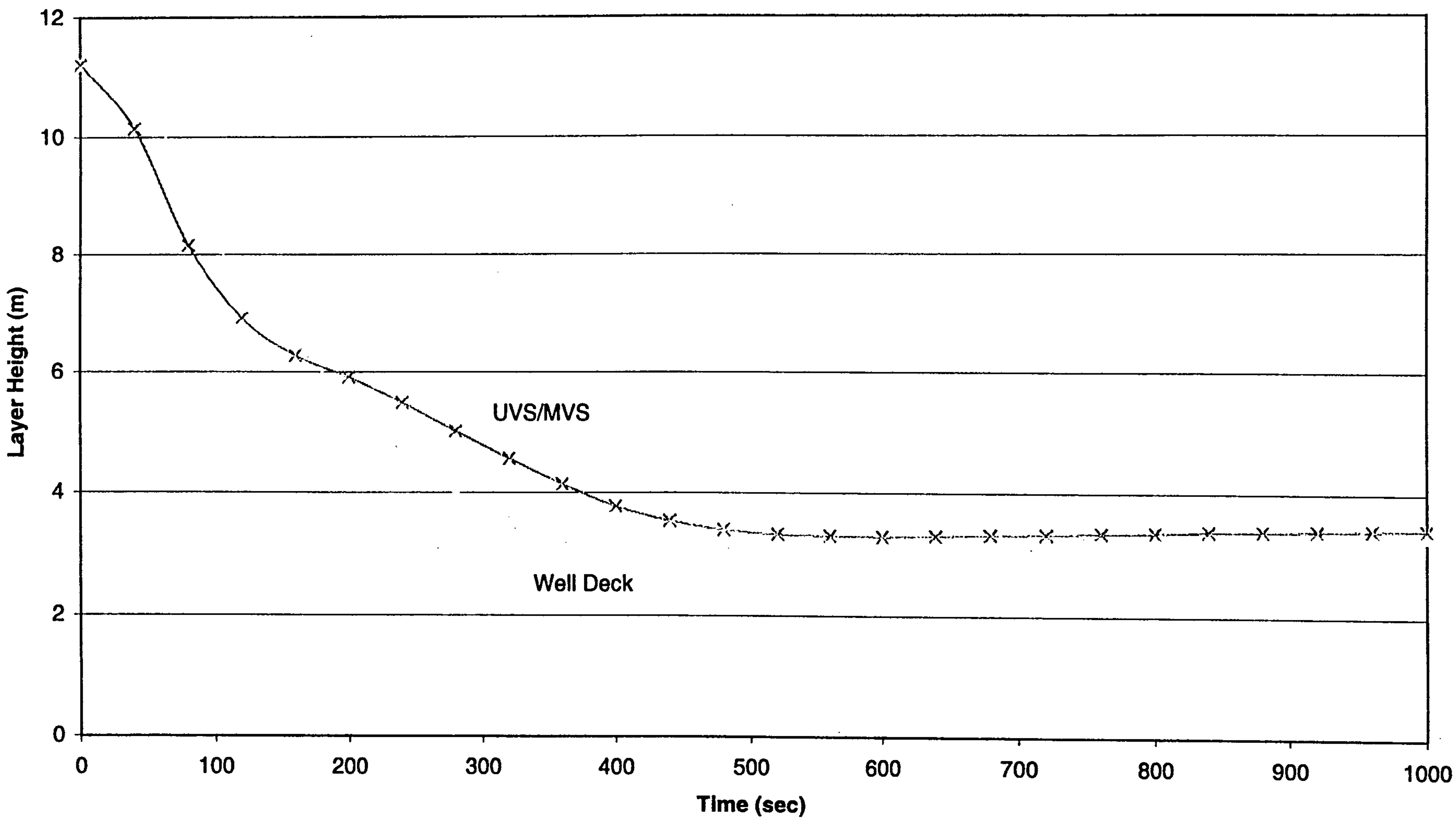
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	30.2	37.2	10.9	10.14	20.4	20.3	0	2000	0	0
80	30.2	40	9.21	8.16	20.4	20.2	0	4000	0	0
120	32.4	45.9	7.42	6.91	20.3	20.2	0	6000	0	0
160	36.2	52.9	6.49	6.27	20.3	20.1	0	8000	0	0
200	40.2	60.6	5.51	5.91	20.2	20	0	10000	0	0
240	44.1	68.1	4.66	5.48	20.2	19.9	0	12000	0	0
280	48.3	74.9	4	5.01	20.1	19.8	0	14000	0	0
320	52.5	80.8	3.49	4.56	20	19.7	0	15000	0	0
360	55.6	83.9	3.18	4.14	20	19.7	0	15000	0	0
400	57.5	85.8	3.1	3.78	20	19.6	0	15000	0	0
440	58.9	87.6	3.13	3.54	19.9	19.6	0	15000	0	0
480	60	89.1	3.17	3.4	19.9	19.6	0	15000	0	0
520	60.9	90.4	3.2	3.33	19.9	19.6	0	15000	0	0
560	61.6	91.3	3.23	3.3	19.9	19.5	0	15000	0	0
600	62.1	92	3.25	3.29	19.9	19.5	0	15000	0	0
640	62.5	92.6	3.26	3.3	19.9	19.5	0	15000	0	0
680	62.8	93	3.28	3.32	19.9	19.5	0	15000	0	0
720	63.1	93.3	3.29	3.33	19.9	19.5	0	15000	0	0
760	63.2	93.6	3.29	3.35	19.9	19.5	0	15000	0	0
800	63.4	93.8	3.3	3.36	19.9	19.5	0	15000	0	0
840	63.5	94	3.31	3.38	19.9	19.5	0	15000	0	0
880	63.6	94.2	3.31	3.39	19.9	19.5	0	15000	0	0
920	63.8	94.3	3.31	3.4	19.9	19.5	0	15000	0	0
960	63.9	94.5	3.32	3.41	19.9	19.5	0	14990	0	0
1000	64	94.7	3.32	3.42	19.9	19.5	0	14990	0	0

```
VERSN     3    Scenario 25
TIMES 1000  40    40    40     0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.2  6.8
MVOPN  2  1 V   8.2  4.0
MVOPN  3  4 V  8.2  4.0
MVOPN  1  5 V  11.2  4.0
MVOPN  3  8 V  11.2  4.0
MVDCT  1  2   0.5  5.6  0.002   0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002   0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002   0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002   0.0 5.6 0.0 5.6
MVFAN  3  2  0.0  1000. 90
MVFAN  7  6   0.0  1000. 90
INELV    1   11.2  2   11.2  3  11.2  4   11.2
INELV    5   11.2  6   11.2  7  11.2  8   11.2
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17nnn.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME   METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME   CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0  0  0  0 2   1 U
TEMPERA 0  0  0  0 2   1 L
TEMPERA 0  0  0  0 2   2 L
```

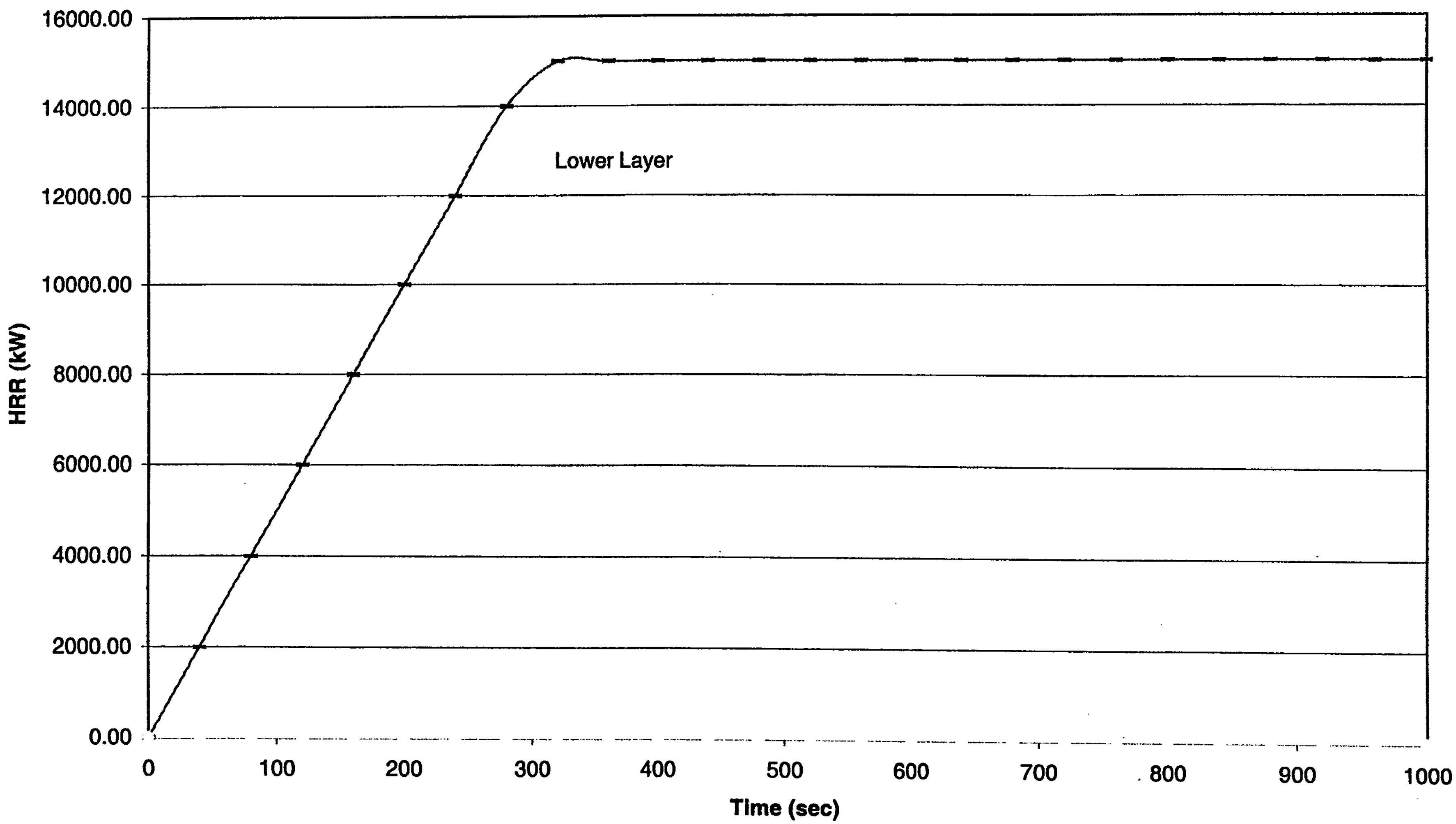
Upper Layer Temperature
MVSA fire
LCAC supply, top stern gate open, no VSA mechanical ventilation



Layer Height
MVSA fire
LCAC supply, top stern gate open, no VSA mechanical ventilation



HRR, UVSA/MVSA
MVSA fire
LCAC supply, top stern gate open, no VSA mechanical ventilation



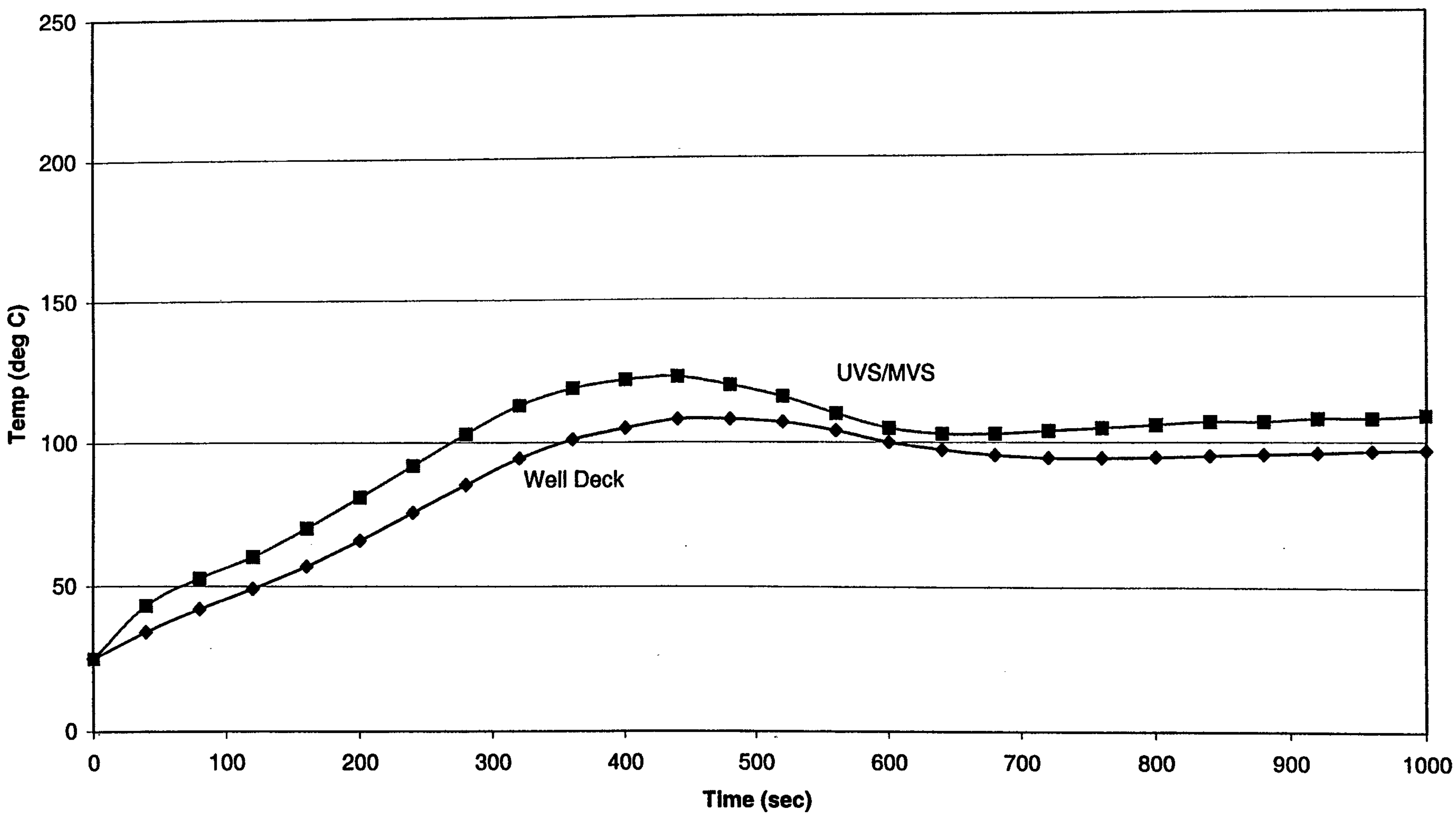
File:	lpd17z.in		
TSG:	closed	**LCAC:**	off
BSG:	closed	**Fans:**	FS, AE
Fire Location:	mvsa	**Opening:**	2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	34.3	43.4	11.0	10.5	20.4	20.3	0.0	2000.0	0.0	0.0
80.0	42.2	52.8	10.5	9.6	20.2	20.1	0.0	4000.0	0.0	0.0
120.0	49.2	60.3	9.9	8.8	20.1	20.0	0.0	6000.0	0.0	0.0
160.0	57.0	70.2	9.4	8.3	20.0	19.8	0.0	8000.0	0.0	0.0
200.0	66.0	80.9	9.0	8.1	19.8	19.7	0.0	10000.0	0.0	0.0
240.0	75.6	91.9	8.6	7.9	19.7	19.5	0.0	12000.0	0.0	0.0
280.0	85.2	103.0	8.2	7.7	19.5	19.4	0.0	14000.0	0.0	0.0
320.0	94.4	113.0	7.7	7.5	19.4	19.2	0.0	15000.0	0.0	0.0
360.0	101.0	119.0	7.3	7.2	19.3	19.1	0.0	15000.0	0.0	0.0
400.0	105.0	122.0	7.0	7.0	19.2	19.1	0.0	15000.0	0.0	0.0
440.0	108.0	123.0	6.7	6.7	19.1	19.1	0.0	15000.0	0.0	0.0
480.0	108.0	120.0	6.3	6.4	19.1	19.1	0.0	15000.0	0.0	0.0
520.0	107.0	116.0	5.9	5.9	19.1	19.2	0.0	15000.0	0.0	0.0
560.0	104.0	110.0	5.3	5.3	19.1	19.2	0.0	15000.0	0.0	0.0
600.0	100.0	105.0	4.6	4.6	19.2	19.3	0.0	15000.0	0.0	0.0
640.0	97.4	103.0	3.9	4.0	19.3	19.3	0.0	15000.0	0.0	0.0
680.0	95.5	103.0	3.3	3.6	19.3	19.3	0.0	15000.0	0.0	0.0
720.0	94.6	104.0	2.8	3.3	19.3	19.3	0.0	15000.0	0.0	0.0
760.0	94.5	105.0	2.3	3.2	19.3	19.3	0.0	14990.0	0.0	0.0
800.0	94.8	106.0	1.9	3.1	19.3	19.3	0.0	13190.0	0.0	1800.0
840.0	95.2	107.0	1.6	3.1	19.3	19.3	0.0	7554.0	0.0	7438.0
880.0	95.7	107.0	1.4	3.0	19.3	19.3	0.0	4918.0	0.0	10070.0
920.0	96.2	108.0	1.2	3.0	19.3	19.3	0.0	3486.0	0.0	11500.0
960.0	96.7	108.0	1.0	3.0	19.3	19.3	0.0	2623.0	0.0	12370.0
1000.0	97.0	109.0	0.9	3.0	19.3	19.3	0.0	2046.0	0.0	12940.0
								1636.0		13350.0

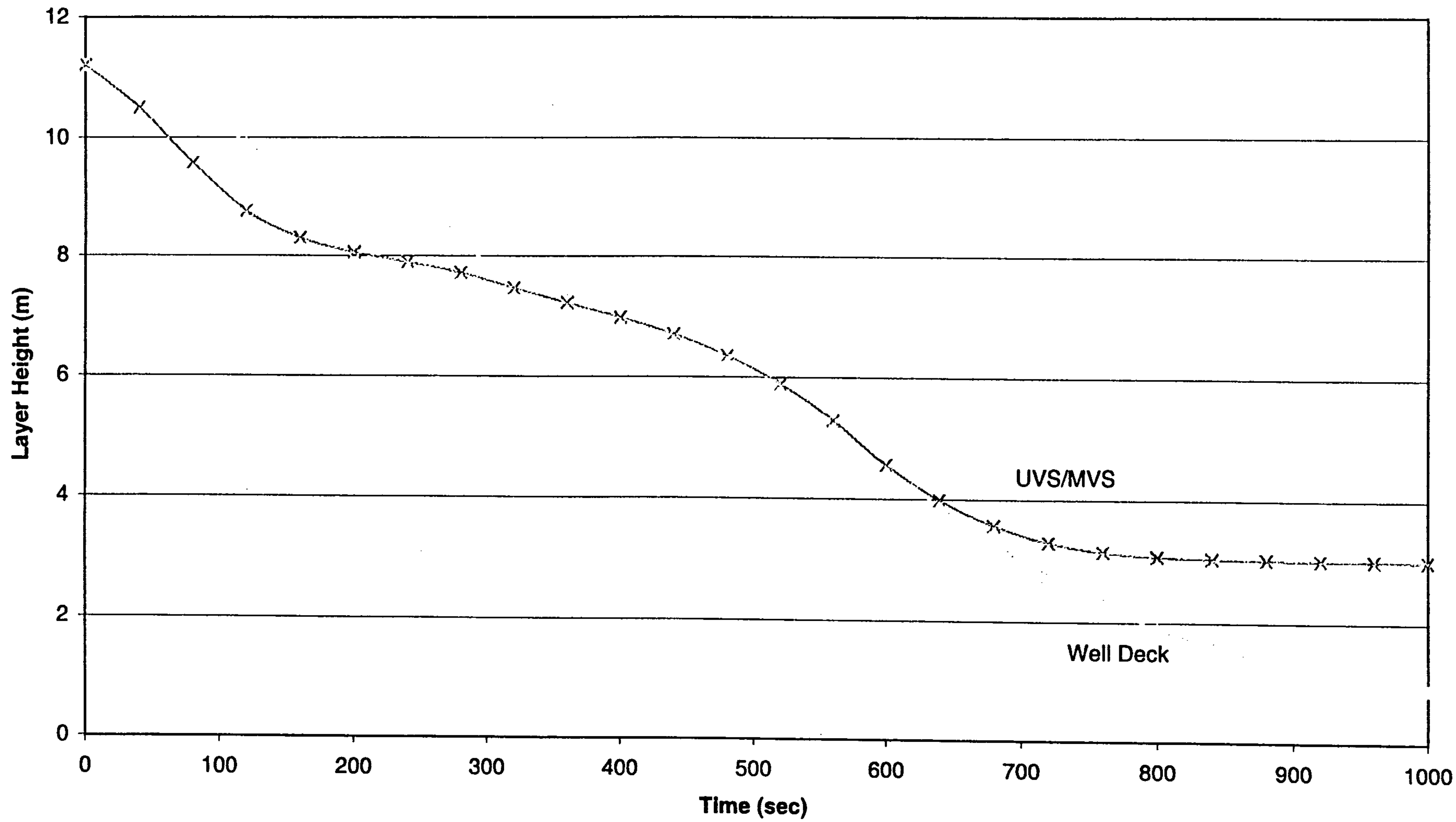
```
VERSN    3  Scenario 26
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  1  9 V   10.0  4.0
MVOPN  3  12 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  10  11   0.0  1000. 75.0
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   10.0  10   10.0  11  10.0  12   10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17z.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME   METERS
```

```
GRAPH    2  740.  300.     0.  1220. 920.    10. 5 TIME   CELSIUS
INTER    0 0 0 0 1    1 U
TEMPERA 0 0 0 0 2    1 U
TEMPERA 0 0 0 0 2    1 L
TEMPERA 0 0 0 0 2    2 L
```

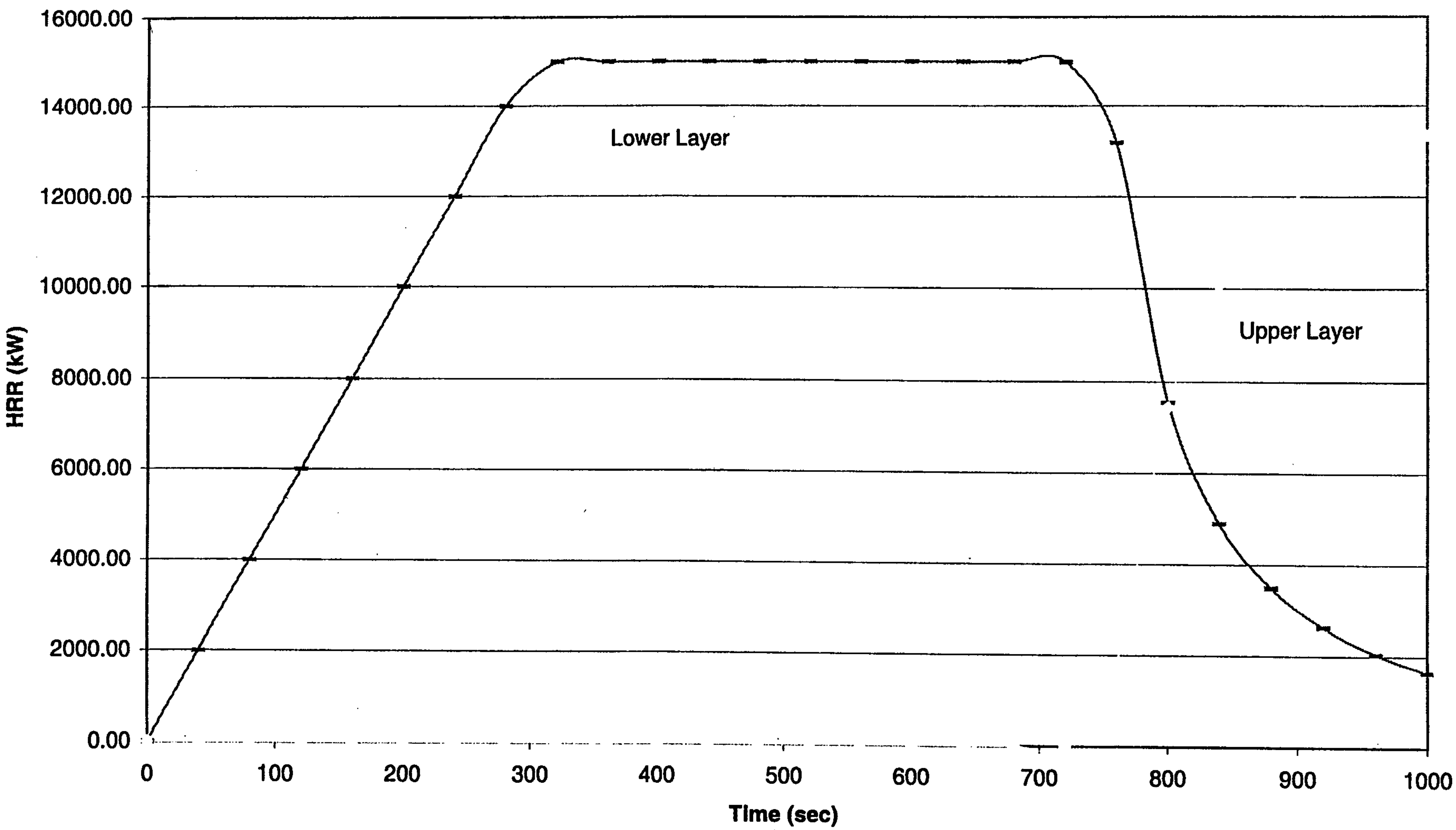
Upper Layer Temperature
MVSA fire
LCAC off, stern gates closed, FS AE mechanical ventilation



Layer Height
MVSA fire
LCAC off, stern gates closed, FS AE mechanical ventilation



HRR, UVSA/MVSA
MVSA fire
LCAC off, stern gates closed, FS AE mechanical ventilation



File: lpd17cc.in
TSG: open
BSG: closed
Fire Location: mvsa

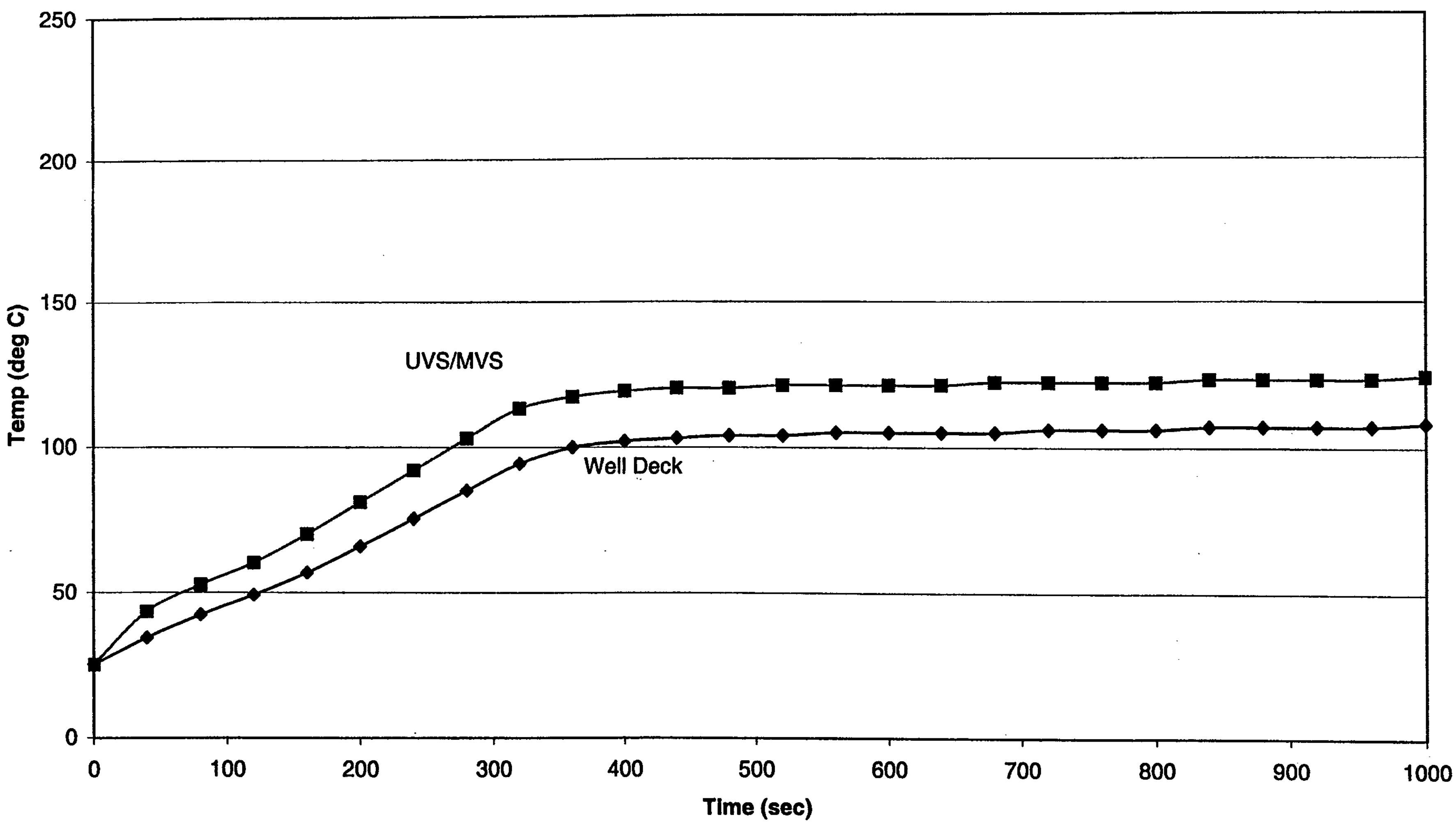
LCAC: off
Fans: FS, AE
Opening: 2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	34.3	43.4	11.0	10.5	20.4	20.3	0.0	2000.0	0.0	0.0
80.0	42.3	52.8	10.6	9.6	20.2	20.1	0.0	4000.0	0.0	0.0
120.0	49.2	60.3	10.0	8.8	20.1	20.0	0.0	6000.0	0.0	0.0
160.0	56.9	70.2	9.7	8.3	20.0	19.8	0.0	8000.0	0.0	0.0
200.0	65.9	81.0	9.5	8.2	19.9	19.7	0.0	10000.0	0.0	0.0
240.0	75.4	92.1	9.3	8.1	19.7	19.5	0.0	12000.0	0.0	0.0
280.0	85.1	103.0	9.3	8.1	19.6	19.4	0.0	14000.0	0.0	0.0
320.0	94.4	113.0	9.2	8.1	19.4	19.2	0.0	15000.0	0.0	0.0
360.0	100.0	117.0	9.3	8.1	19.3	19.2	0.0	15000.0	0.0	0.0
400.0	102.0	119.0	9.3	8.1	19.3	19.2	0.0	15000.0	0.0	0.0
440.0	103.0	120.0	9.3	8.1	19.3	19.1	0.0	15000.0	0.0	0.0
480.0	104.0	120.0	9.3	8.1	19.3	19.1	0.0	15000.0	0.0	0.0
520.0	104.0	121.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
560.0	105.0	121.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
600.0	105.0	121.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
640.0	105.0	121.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
680.0	105.0	122.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
720.0	106.0	122.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
760.0	106.0	122.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
800.0	106.0	122.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
840.0	107.0	123.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
880.0	107.0	123.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
920.0	107.0	123.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
960.0	107.0	123.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
1000.0	108.0	124.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0

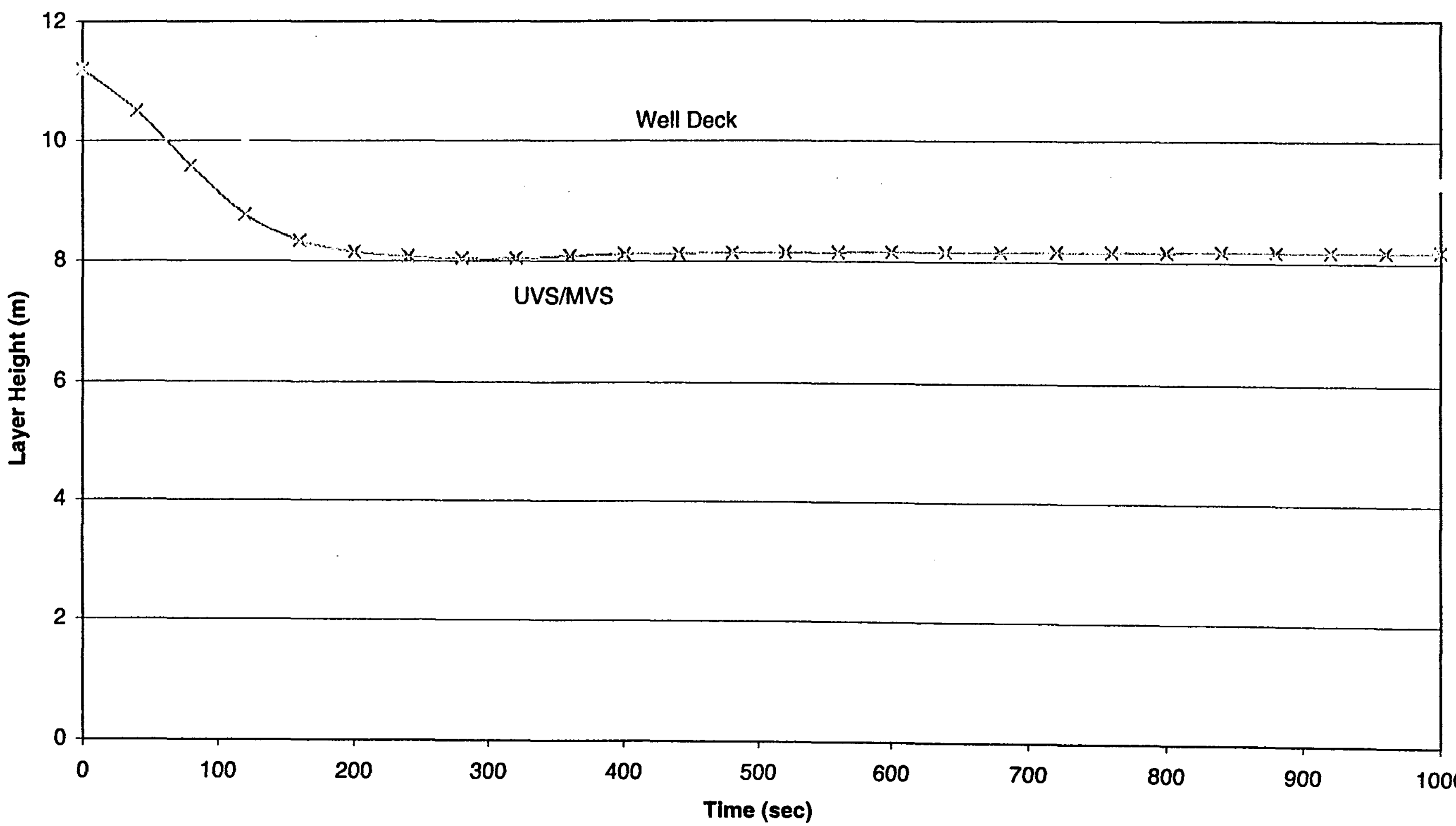
```
VERSN    3  Scenario 27
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8 5.0  0.0
HVENT  1  3  2   18.5 11.0 6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  1  9 V   10.0  4.0
MVOPN  3  12 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  10  11   0.0  1000. 75.0
INELV    1   10.0  2    10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   10.0  10   10.0  11  10.0  12   10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 16. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17cc.hi
DEVICE 1
WINDOW      0     0  -100  1280  1024   1100
```

```
GRAPH    1  120.   300.     0.  600.  920.    10. 5 TIME  METERS
GRAPH    2  740.   300.     0.  1220. 920.    10. 5 TIME  CELSIUS
INTER    0 0 0 0 1    1 U
TEMPERA  0 0 0 0 2    1 U
TEMPERA  0 0 0 0 2    1 L
TEMPERA  0 0 0 0 2    2 L
```

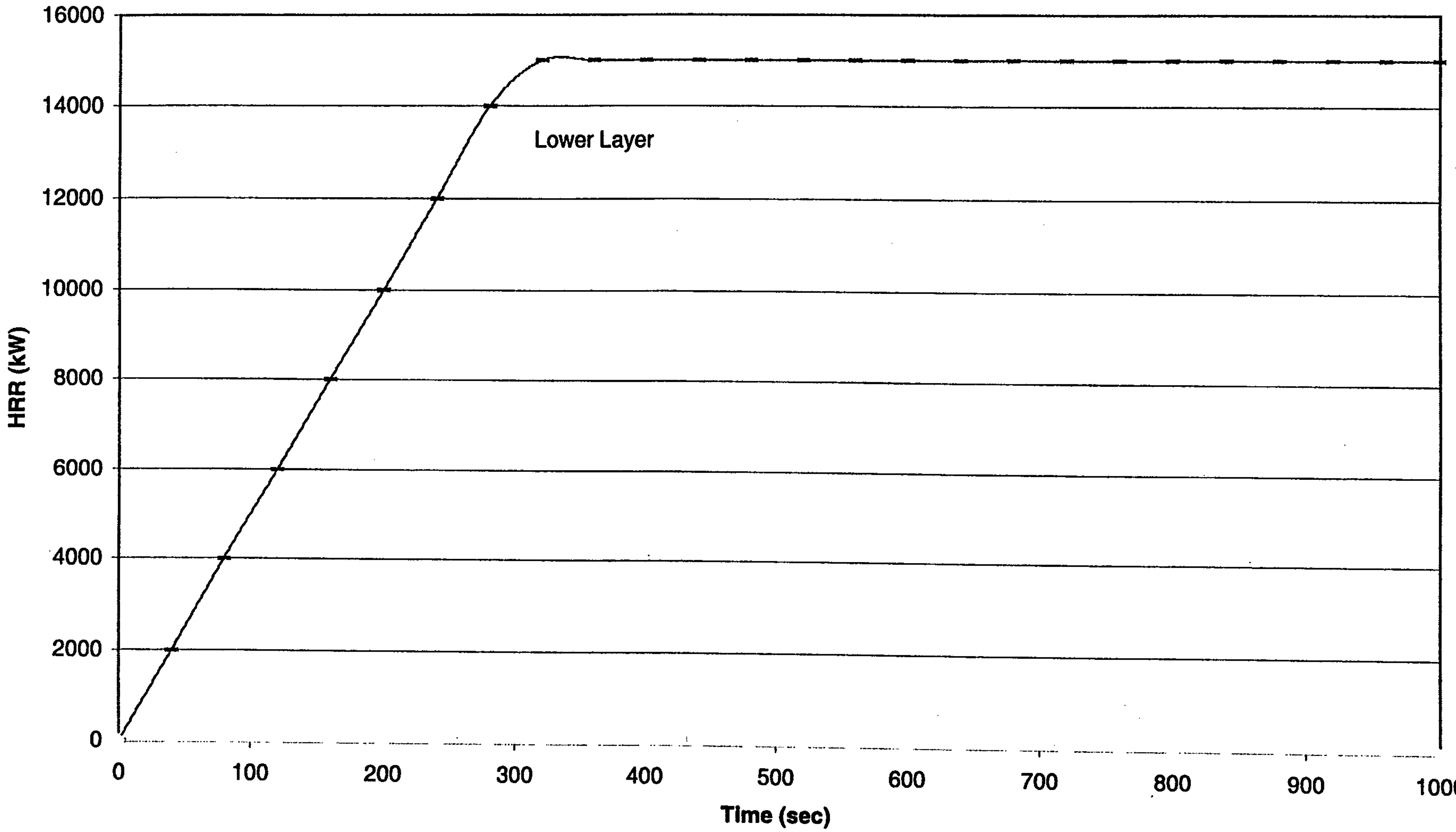
Upper Layer Temperature
MVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open



Layer Height
MVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open



HRR, MVSA/UVSA
MVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open



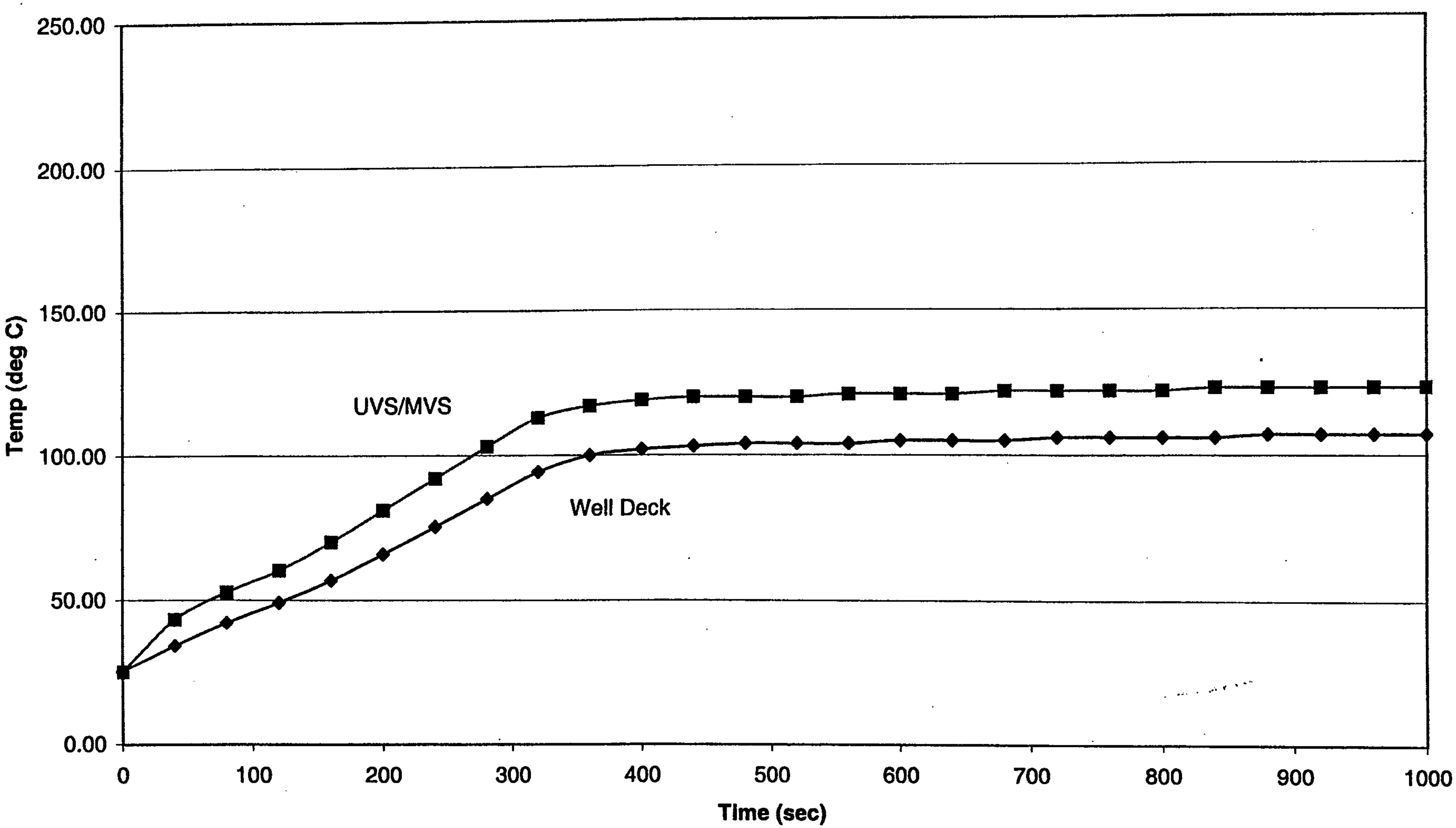
File:	lpd17ff.in		
TSG:	open	LCAC:	off
BSG:	open	Fans:	FS, AE
Fire Location:	mvsa	Opening:	2.8 x 5.0

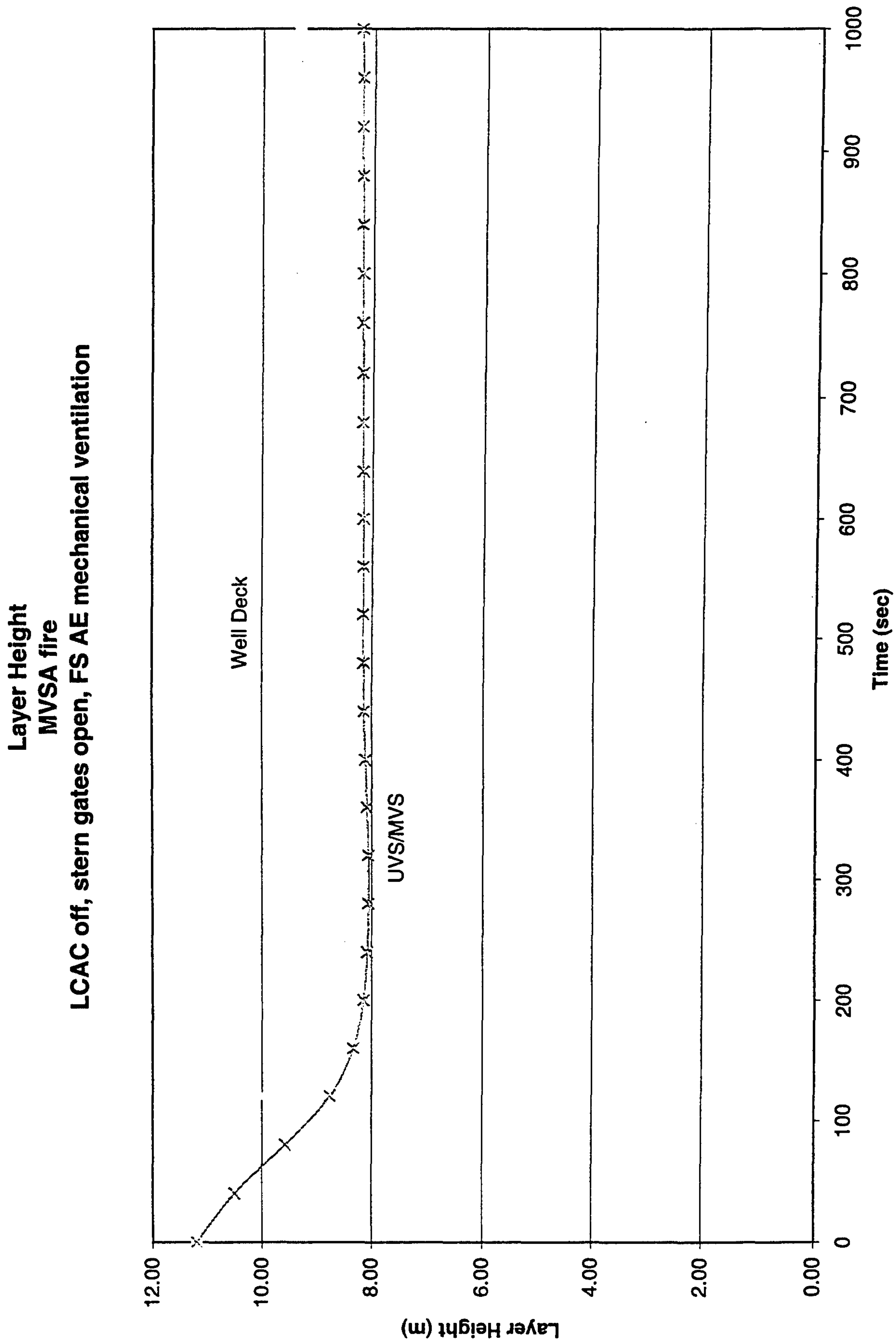
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	34.3	43.4	11.0	10.5	20.4	20.3	0.0	2000.0	0.0	0.0
80.0	42.3	52.8	10.6	9.6	20.2	20.1	0.0	4000.0	0.0	0.0
120.0	49.2	60.3	10.0	8.8	20.1	20.0	0.0	6000.0	0.0	0.0
160.0	56.9	70.2	9.7	8.3	20.0	19.8	0.0	8000.0	0.0	0.0
200.0	65.9	81.0	9.5	8.2	19.9	19.7	0.0	10000.0	0.0	0.0
240.0	75.4	92.1	9.3	8.1	19.7	19.5	0.0	12000.0	0.0	0.0
280.0	85.0	103.0	9.3	8.1	19.6	19.4	0.0	14000.0	0.0	0.0
320.0	94.3	113.0	9.3	8.1	19.4	19.2	0.0	15000.0	0.0	0.0
360.0	100.0	117.0	9.3	8.1	19.3	19.2	0.0	15000.0	0.0	0.0
400.0	102.0	119.0	9.3	8.1	19.3	19.2	0.0	15000.0	0.0	0.0
440.0	103.0	120.0	9.3	8.1	19.3	19.1	0.0	15000.0	0.0	0.0
480.0	104.0	120.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
520.0	104.0	120.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
560.0	104.0	121.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
600.0	105.0	121.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
640.0	105.0	121.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
680.0	105.0	122.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
720.0	106.0	122.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
760.0	106.0	122.0	9.3	8.2	19.3	19.1	0.0	15000.0	0.0	0.0
800.0	106.0	122.0	9.3	8.2	19.3	19.2	0.0	15000.0	0.0	0.0
840.0	106.0	123.0	9.3	8.2	19.3	19.2	0.0	15000.0	0.0	0.0
880.0	107.0	123.0	9.3	8.2	19.3	19.2	0.0	15000.0	0.0	0.0
920.0	107.0	123.0	9.3	8.2	19.3	19.2	0.0	15000.0	0.0	0.0
960.0	107.0	123.0	9.3	8.2	19.3	19.2	0.0	15000.0	0.0	0.0
1000.0	107.0	123.0	9.3	8.2	19.3	19.2	0.0	15000.0	0.0	0.0

```
VERSN    3  Scenario 28
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  1  9 V   10.0  4.0
MVOPN  3  12 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  10  11   0.0  1000. 75.0
INELV    1   10.0  2    10.0  3  10.0  4    10.0
INELV    5   6.0  6     6.0  7  6.0  8    6.0
INELV    9   10.0  10   10.0  11  10.0  12   10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO     .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR 1pd17ff.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
```

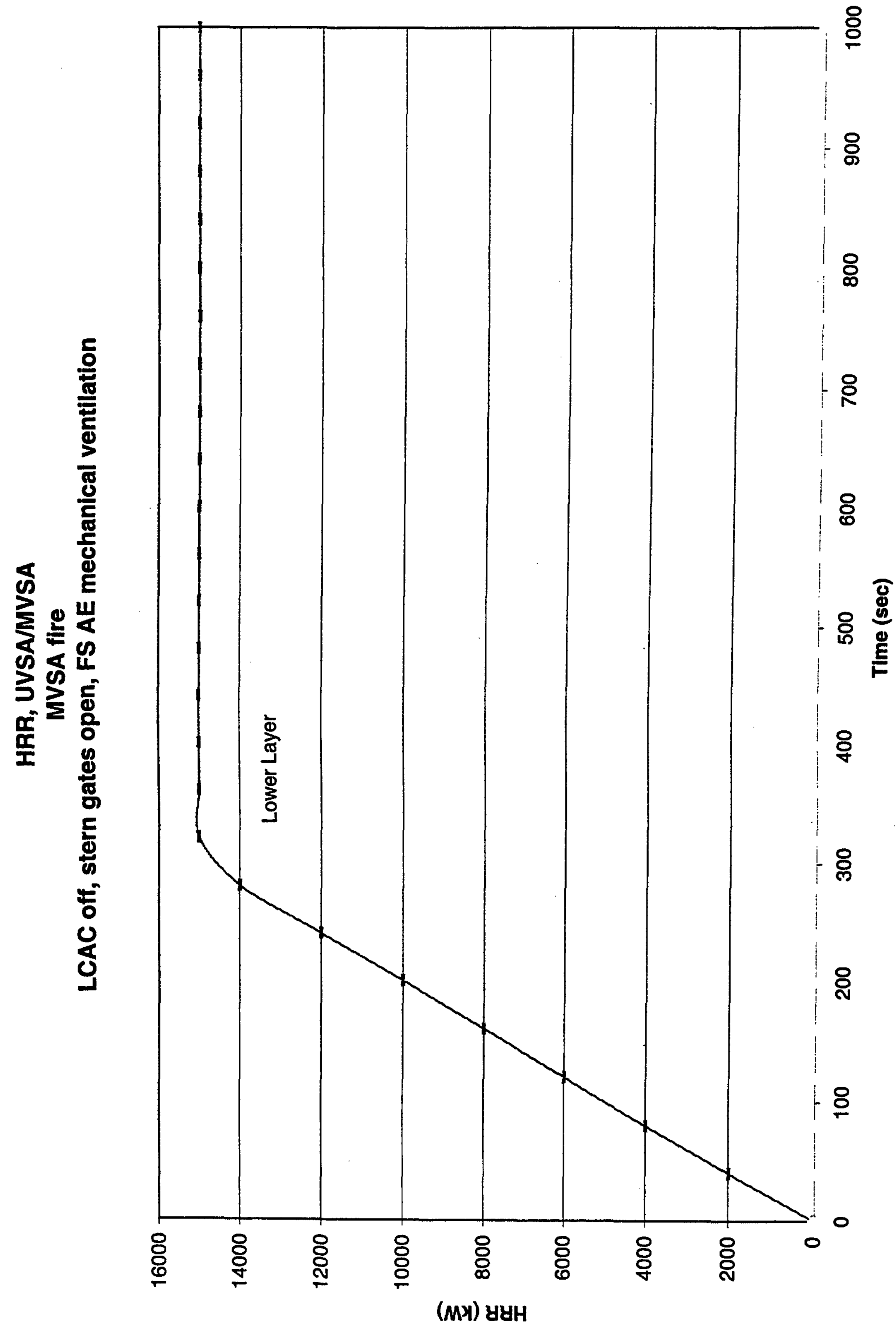
```
GRAPH   1  120.  300.     0.  600.  920.    10. 5 TIME  METERS
GRAPH   2  740.  300.     0.  1220. 920.    10. 5 TIME  CELSIUS
INTER   0 0 0 0 1    1 U
TEMPERA 0 0 0 0 2    1 U
TEMPERA 0 0 0 0 2    1 L
TEMPERA 0 0 0 0 2    2 L
```

Upper Layer Temperature
MVSA fire
LCAC off, stern gates open, FS AE mechanical ventilation





Layer Height
MVSA fire
LCAC off, stern gates open, FS AE mechanical ventilation
Well Deck
UVS/MVS
Layer Height (m)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Time (sec)
0
100
200
300
400
500
600
700
800
900
1000


HRR, UVSA/MVSA
MVSA fire
LCAC off, stern gates open, FS AE mechanical ventilation
Lower Layer
HRR (kW)
16000
14000
12000
10000
8000
6000
4000
2000
0
Time (sec)
0
100
200
300
400
500
600
700
800
900
1000

File: lpd17xx.in
TSG: open
BSG: closed
Fire Location: mvsa

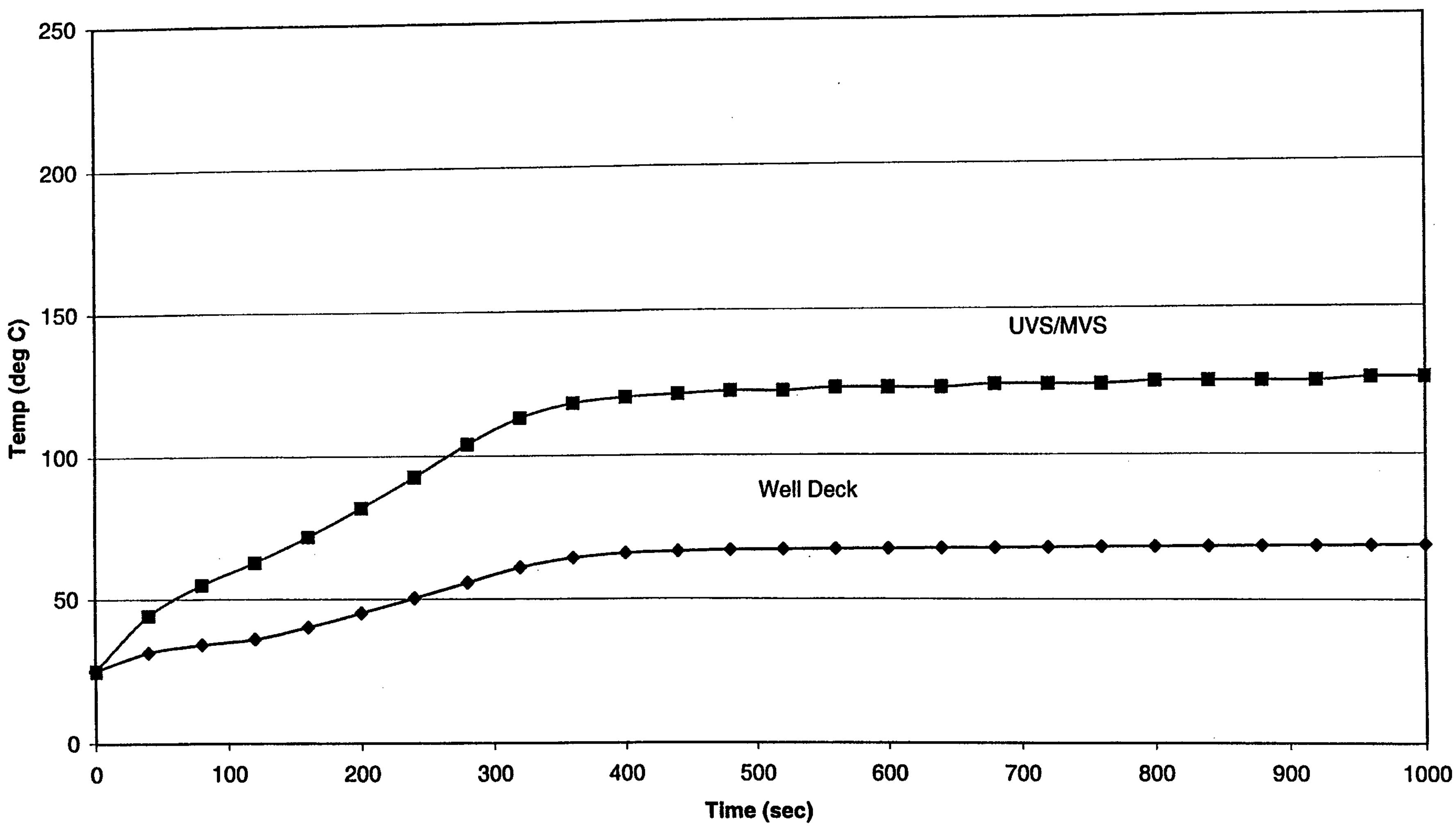
LCAC: supply
Fans: FS,AE
Opening: 2.8 x 5.0

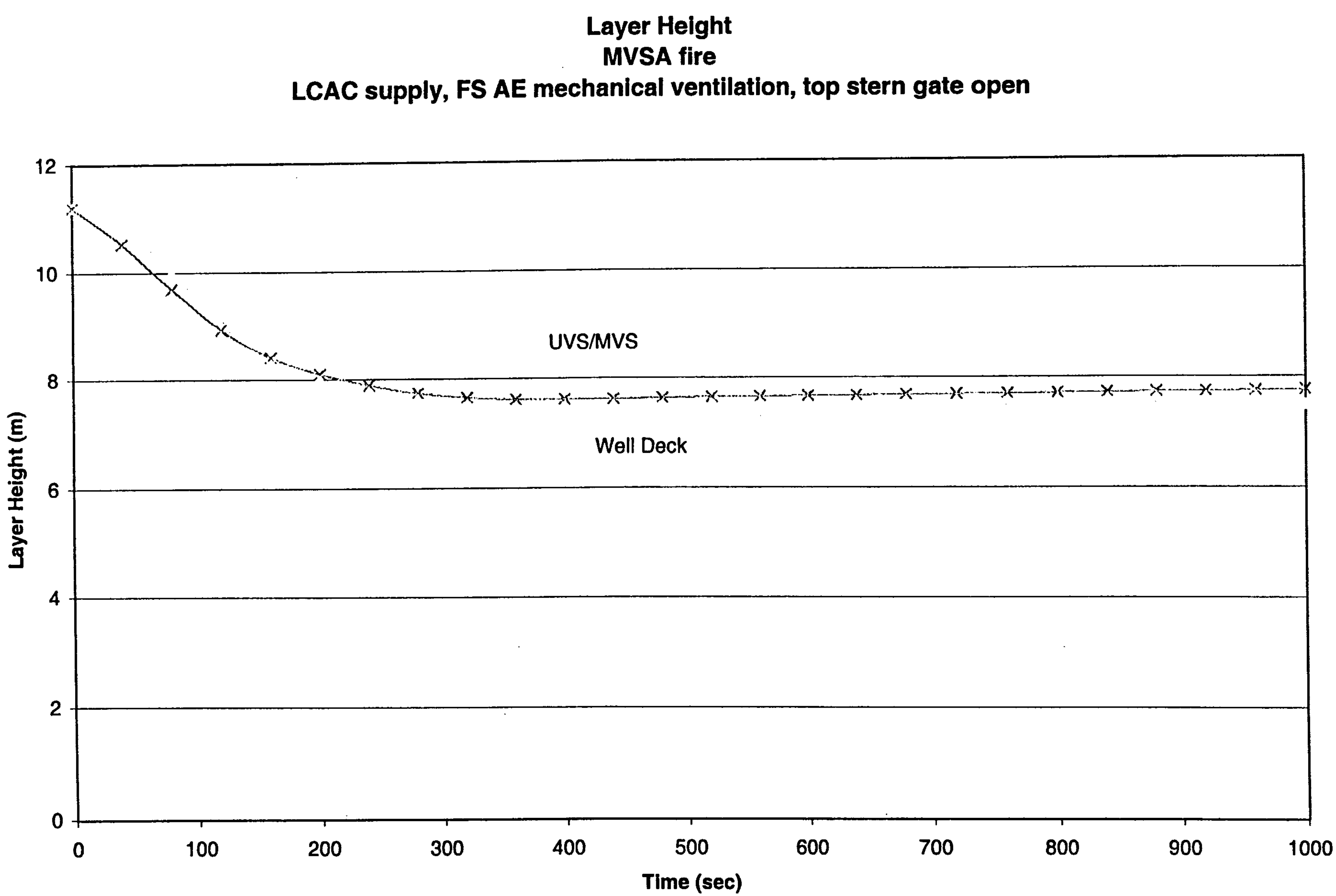
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	31.4	44.3	10.9	10.5	20.4	20.3	0.0	2000.0	0.0	0.0
80.0	34.2	54.9	10.0	9.7	20.3	20.2	0.0	4000.0	0.0	0.0
120.0	36.1	62.8	9.0	8.9	20.3	20.0	0.0	5999.0	0.0	0.0
160.0	40.2	71.9	8.4	8.4	20.2	19.8	0.0	7999.0	0.0	0.0
200.0	45.2	82.2	8.0	8.1	20.1	19.7	0.0	9999.0	0.0	0.0
240.0	50.4	92.8	7.7	7.9	20.1	19.5	0.0	12000.0	0.0	0.0
280.0	55.7	104.0	7.5	7.7	20.0	19.4	0.0	14000.0	0.0	0.0
320.0	61.0	113.0	7.4	7.7	19.9	19.2	0.0	15000.0	0.0	0.0
360.0	64.3	118.0	7.3	7.6	19.9	19.2	0.0	15000.0	0.0	0.0
400.0	65.9	120.0	7.3	7.6	19.8	19.1	0.0	15000.0	0.0	0.0
440.0	66.6	121.0	7.4	7.6	19.8	19.1	0.0	15000.0	0.0	0.0
480.0	67.0	122.0	7.4	7.6	19.8	19.1	0.0	15000.0	0.0	0.0
520.0	67.2	122.0	7.4	7.6	19.8	19.1	0.0	15000.0	0.0	0.0
560.0	67.4	123.0	7.4	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
600.0	67.5	123.0	7.4	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
640.0	67.7	123.0	7.4	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
680.0	67.8	124.0	7.4	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
720.0	68.0	124.0	7.4	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
760.0	68.1	124.0	7.4	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
800.0	68.2	125.0	7.4	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
840.0	68.3	125.0	7.4	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
880.0	68.5	125.0	7.5	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
920.0	68.6	125.0	7.5	7.7	19.8	19.1	0.0	15000.0	0.0	0.0
960.0	68.7	126.0	7.5	7.8	19.8	19.1	0.0	15000.0	0.0	0.0
1000.0	68.9	126.0	7.5	7.8	19.8	19.1	0.0	15000.0	0.0	0.0

```
VERSN    3  Scenario 29
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.0  6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   9.0  4.0
MVOPN  2  12 V  9.0  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVOPN  1  17 V   10.0  4.0
MVOPN  3  20 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  17 18   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  19 20   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  11 10   0.0  1000. 90
MVFAN  15 14   0.0  1000. 90
MVFAN  18 19   0.0  1000. 75
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   12.0  10   12.0  11  12.0  12   12.0
INELV    13   11.2  14   11.2  15  11.2  16   11.2
INELV    17   10.0   18   10.0  19  10.0   20  10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
```

```
OD     .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17xx.hi
DEVICE 1
WINDOW        0      0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

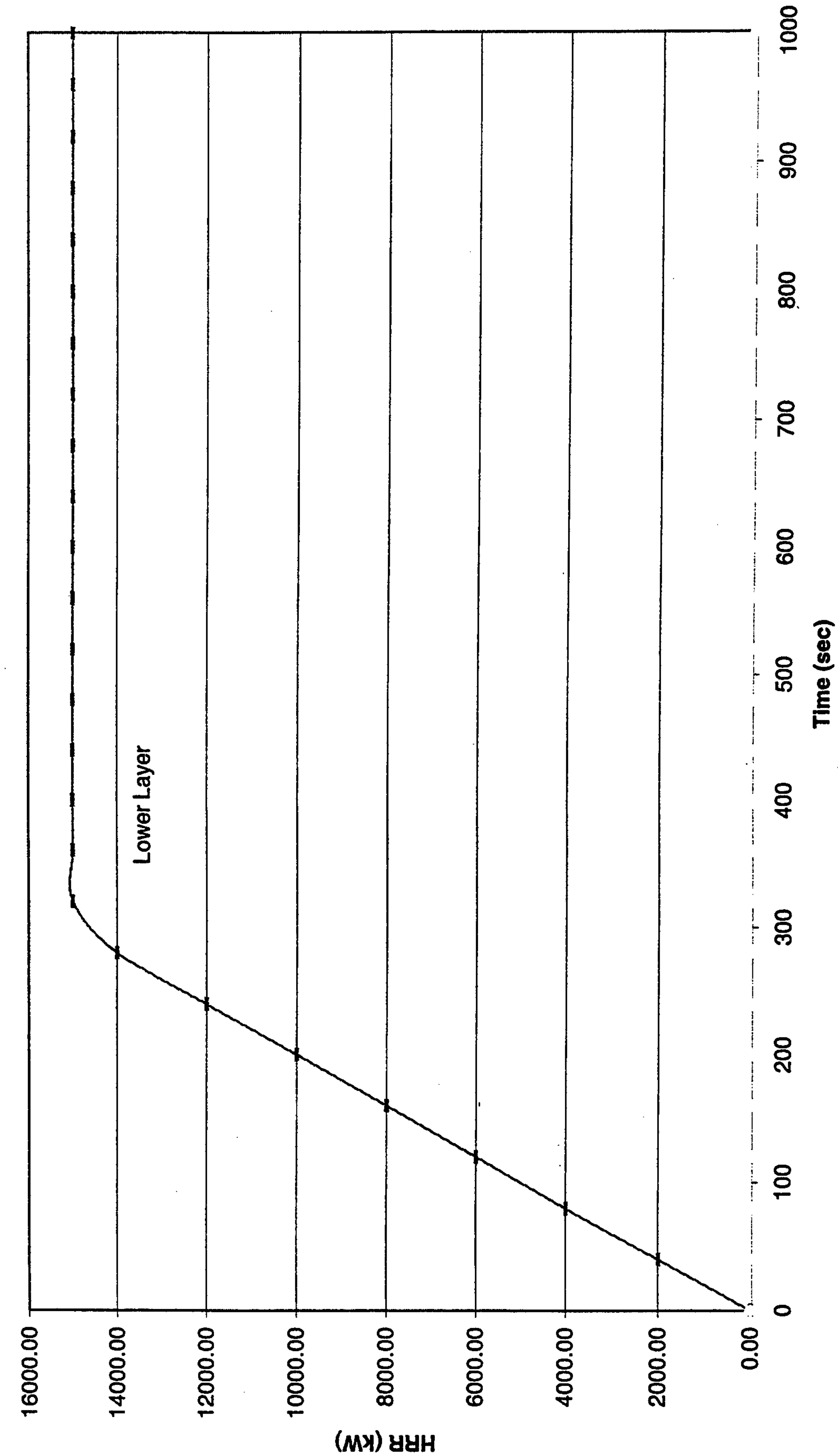
Upper Layer Temperature
MVSA fire
LCAC supply, FS AE mechanical ventilation, top stern gate open





Layer Height
MVSA fire
LCAC supply, FS AE mechanical ventilation, top stern gate open
UVS/MVS
Well Deck
Layer Height (m)
Time (sec)
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000

HRR, UVSA/MVSA
MVSA fire
LCAC supply, FS AE mechanical ventilation, top stern gate open



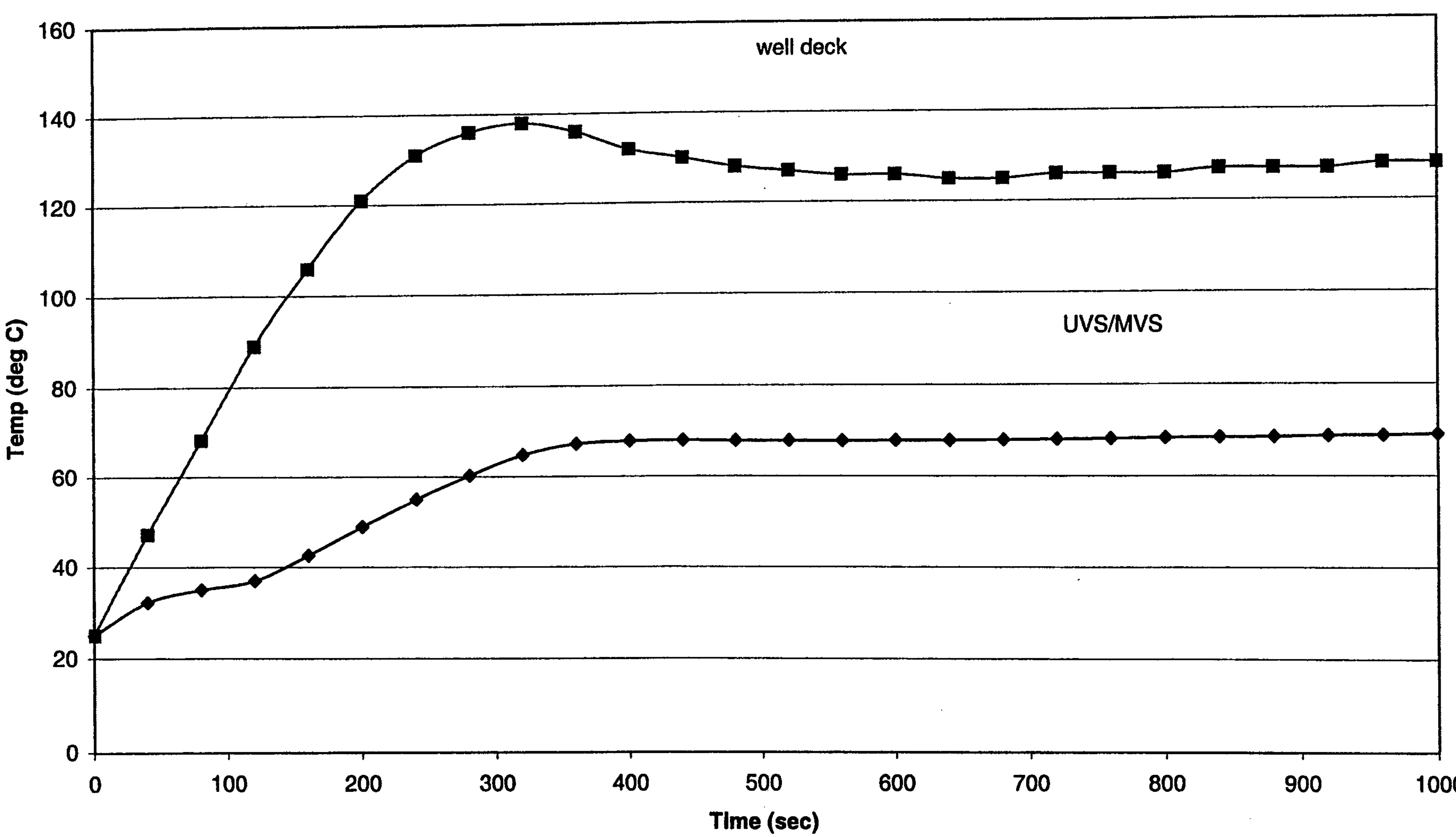
File:	lpd17aaa.in		
TSG:	open	**LCAC:**	reversed
BSG:	open	**Fans:**	FS,AE
Fire Location:	mvsa	**Opening:**	2.8 x 5.0

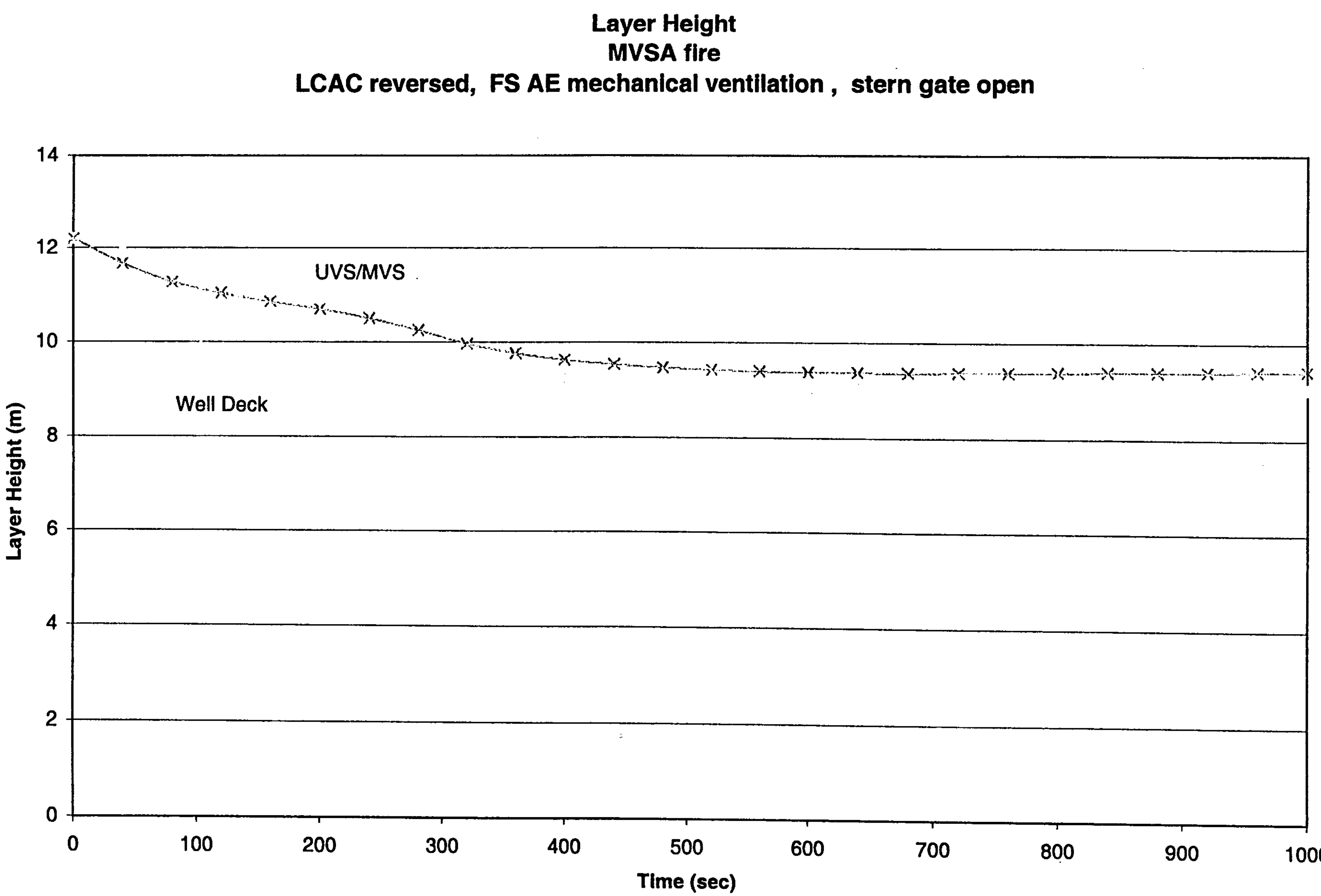
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2	Visibility (m) Comp. 1	Visibility (m) Comp. 2
0.00E+00	25	25	12.2	12.2	20.6	20.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	30	30
40	32.2	47.2	12	11.67	20.4	20.3	0.00E+00	2.00E+03	0.00E+00	7.46E-14	27.42616	12.03704
80	35	68.1	10.7	11.27	20.3	20.1	0.00E+00	4.00E+03	0.00E+00	2.98E-13	26.10442	7.878788
120	37	89	9.63	11.04	20.3	19.8	0.00E+00	6.00E+03	0.00E+00	5.97E-13	25.54028	6.341463
160	42.6	106	9.49	10.86	20.2	19.6	0.00E+00	8.00E+03	0.00E+00	5.97E-13	20.18634	5.963303
200	48.9	121	9.52	10.7	20.1	19.4	0.00E+00	1.00E+04	0.00E+00	1.19E-12	17.61518	6.280193
240	55	131	9.53	10.5	20	19.2	0.00E+00	1.20E+04	0.00E+00	1.19E-12	17.80822	7.647059
280	60.2	136	9.49	10.25	19.9	19	0.00E+00	1.40E+04	0.00E+00	1.19E-12	21.4168	11.30435
320	64.7	138	9.41	9.96	19.9	18.9	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	24.66793
360	67.1	136	9.33	9.76	19.8	18.9	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
400	67.8	132	9.26	9.62	19.8	18.9	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
440	67.9	130	9.19	9.53	19.8	19	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
480	67.8	128	9.14	9.46	19.8	19	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
520	67.8	127	9.1	9.42	19.8	19	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
560	67.7	126	9.08	9.39	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
600	67.8	126	9.06	9.37	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
640	67.8	125	9.04	9.37	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
680	67.9	125	9.03	9.36	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
720	68	126	9.03	9.37	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
760	68.1	126	9.03	9.37	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
800	68.3	126	9.03	9.38	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
840	68.4	127	9.03	9.39	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
880	68.5	127	9.03	9.39	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
920	68.7	127	9.04	9.4	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
960	68.8	128	9.04	9.41	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30
1.00E+03	69	128	9.05	9.42	19.8	19.1	0.00E+00	1.50E+04	0.00E+00	1.19E-12	30	30

```
VERSN    3  Scenario 30
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.0 0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   9.0  4.0
MVOPN  2  12 V  9.0  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVOPN  1  17 V   10.0  4.0
MVOPN  3  20 V  10.0  4.0
MVDCT  1  2    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  17 18    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  19 20    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2    0.0  1000. 42.5
MVFAN  7  6    0.0  1000. 42.5
MVFAN  11 10    0.0  1000. 90
MVFAN  15 14    0.0  1000. 90
MVFAN  18 19    0.0  1000. 75
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   12.0  10   12.0  11  12.0  12   12.0
INELV    13   11.2  14   11.2  15  11.2  16   11.2
INELV    17   10.0  18   10.0  19  10.0   20  10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
```

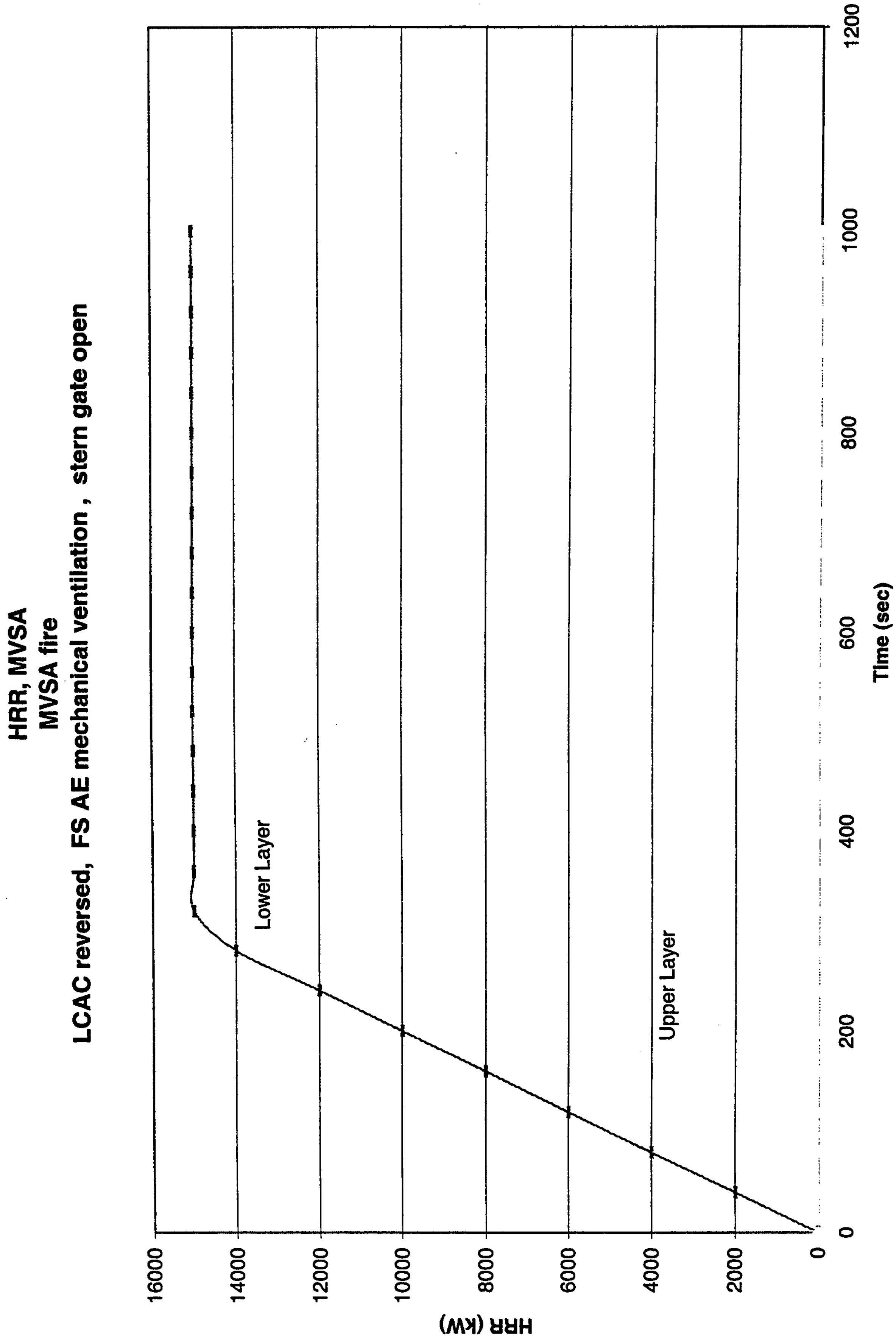
```
OD     .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17aaa.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
MVSA fire
LCAC reversed, FS AE mechanical ventilation , stern gate open





Layer Height
MVSA fire
LCAC reversed, FS AE mechanical ventilation , stern gate open
UVS/MVS
Well Deck
Layer Height (m)
14
12
10
8
6
4
2
0
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)


HRR, MVSA
MVSA fire
LCAC reversed, FS AE mechanical ventilation , stern gate open
Lower Layer
Upper Layer
HRR (kW)
Time (sec)
16000
14000
12000
10000
8000
6000
4000
2000
0
0
200
400
600
800
1000
1200

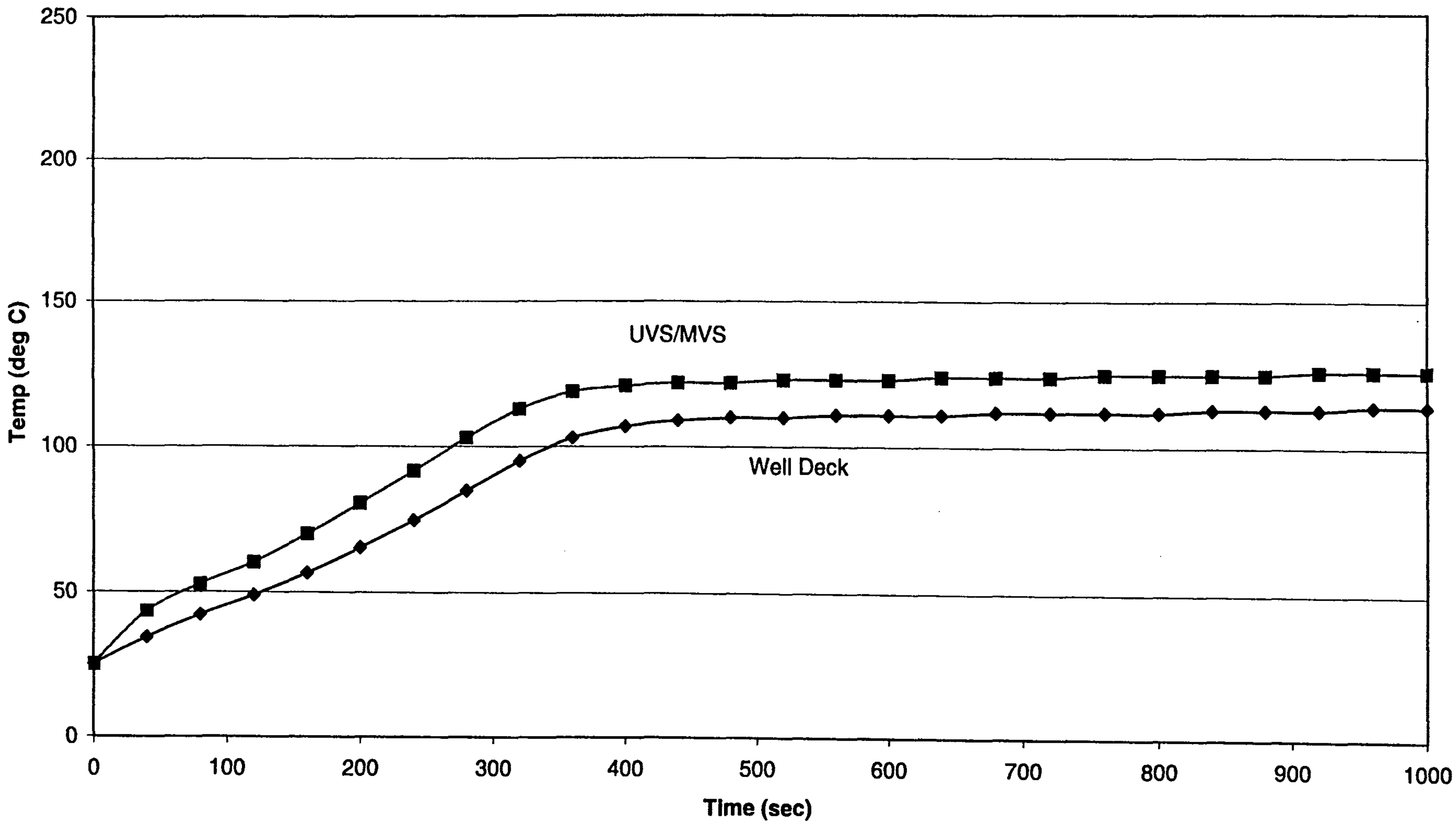
File: lpd17jjj.in
TSG: open
BSG: closed
Fire Location: MVSA

LCAC: off
Fans: FS
Opening: 2.8 x 5.0

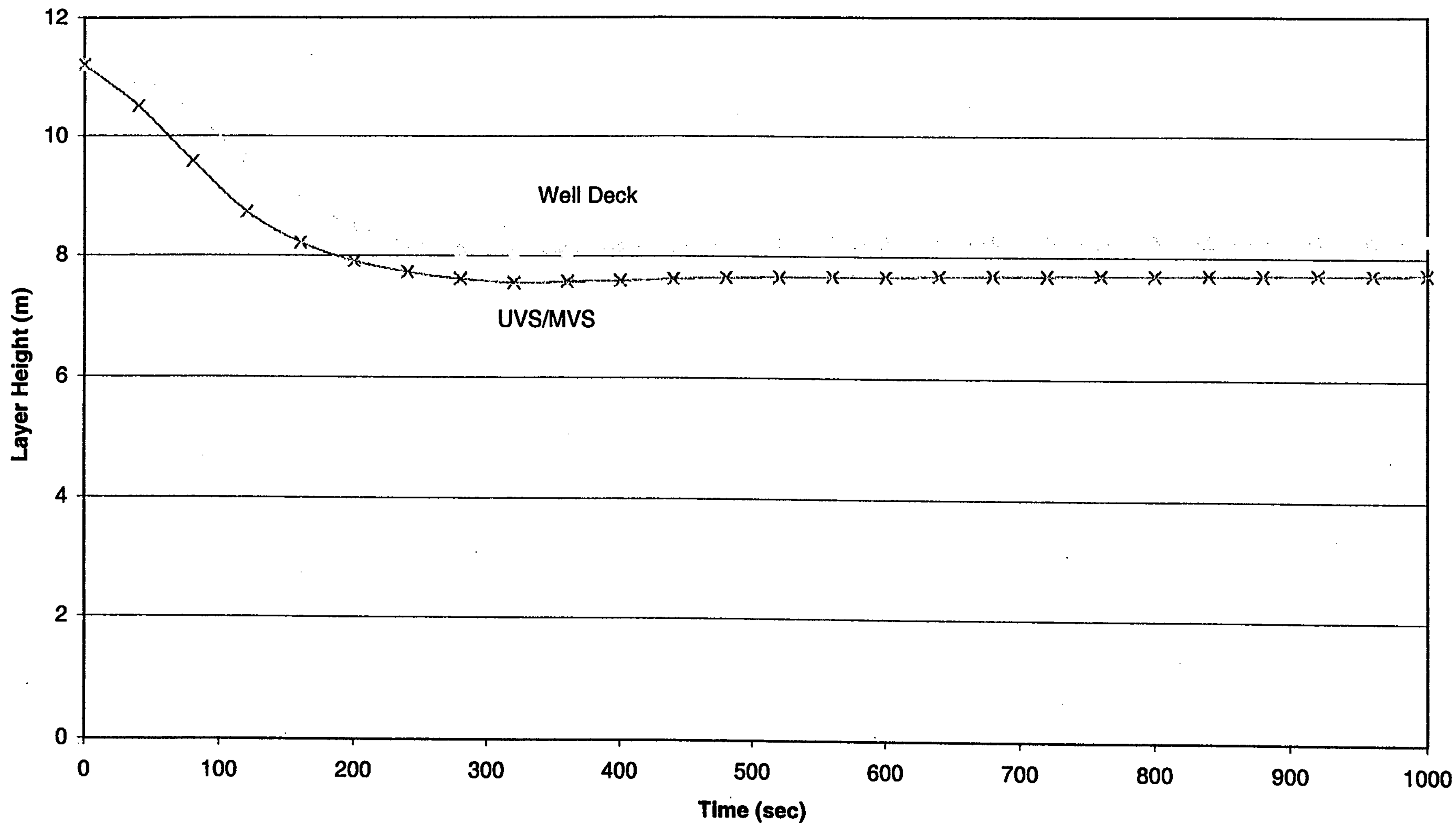
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	34.3	43.4	11.0	10.5	20.4	20.3	0.0	2000.0	0.0	0.0
80.0	42.1	52.8	10.4	9.6	20.2	20.1	0.0	4000.0	0.0	0.0
120.0	49.0	60.3	9.6	8.7	20.1	20.0	0.0	6000.0	0.0	0.0
160.0	56.6	70.1	8.9	8.2	20.0	19.8	0.0	8000.0	0.0	0.0
200.0	65.4	80.7	8.5	7.9	19.9	19.7	0.0	10000.0	0.0	0.0
240.0	74.9	91.7	8.2	7.7	19.7	19.5	0.0	12000.0	0.0	0.0
280.0	84.9	103.0	8.1	7.6	19.5	19.4	0.0	14000.0	0.0	0.0
320.0	95.1	113.0	8.1	7.6	19.4	19.2	0.0	15000.0	0.0	0.0
360.0	103.0	119.0	8.1	7.6	19.3	19.1	0.0	15000.0	0.0	0.0
400.0	107.0	121.0	8.1	7.6	19.2	19.1	0.0	15000.0	0.0	0.0
440.0	109.0	122.0	8.2	7.6	19.2	19.1	0.0	15000.0	0.0	0.0
480.0	110.0	122.0	8.2	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
520.0	110.0	123.0	8.2	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
560.0	111.0	123.0	8.2	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
600.0	111.0	123.0	8.2	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
640.0	111.0	124.0	8.2	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
680.0	112.0	124.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
720.0	112.0	124.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
760.0	112.0	125.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
800.0	112.0	125.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
840.0	113.0	125.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
880.0	113.0	125.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
920.0	113.0	126.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
960.0	114.0	126.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0
1000.0	114.0	126.0	8.3	7.7	19.1	19.1	0.0	15000.0	0.0	0.0

```
VERSN    3  Scenario 31
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5  11.0  6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
INELV   1   10.0  2   10.0  3  10.0  4   10.0
INELV   5   6.0  6    6.0  7  6.0  8   6.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17jjj.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.    10. 5 TIME   METERS
GRAPH   2  740.  300.    0.  1220. 920.    10. 5 TIME   CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

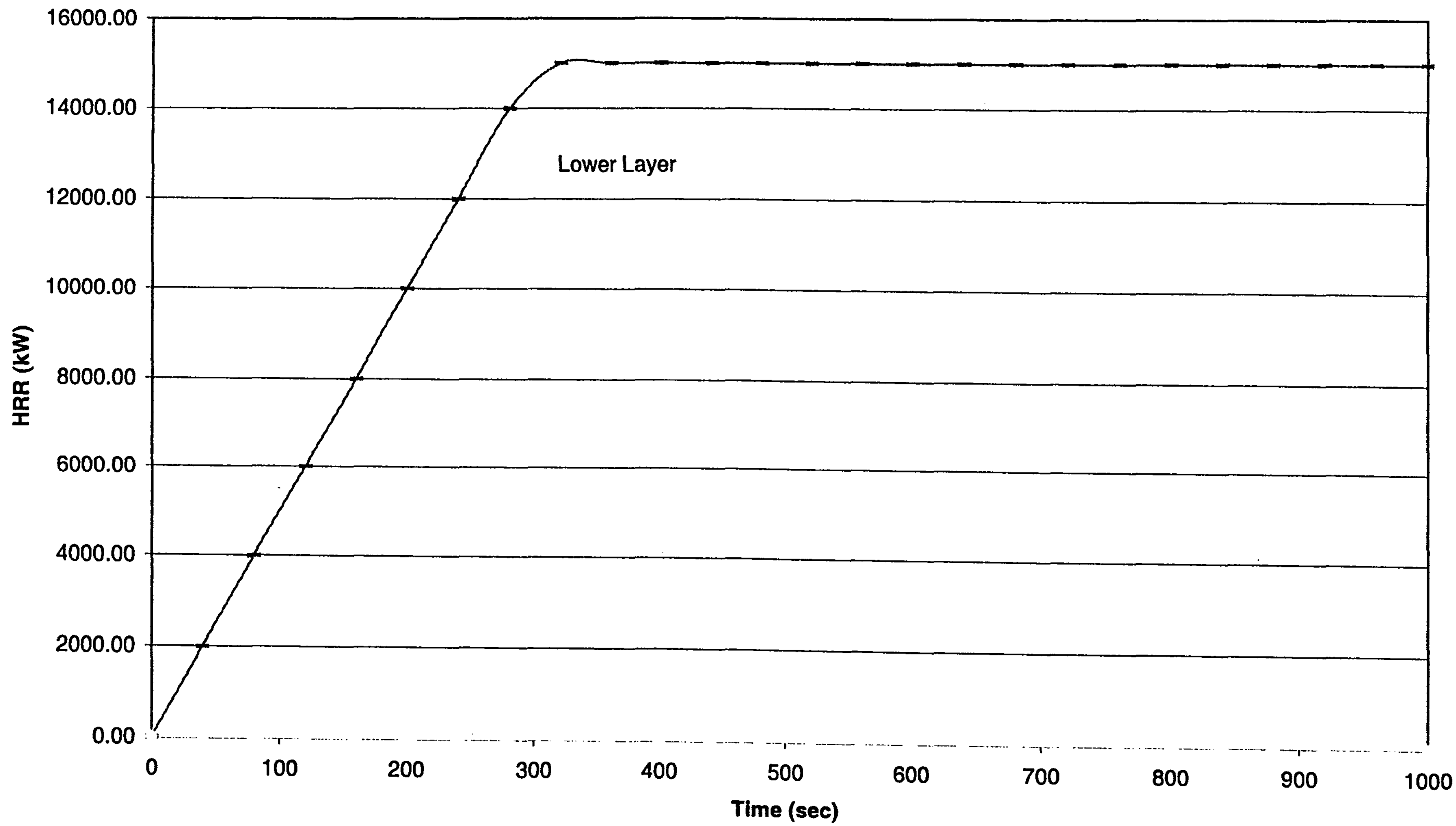
Upper Layer Temperature
MVSA fire
LCAC off, top stern gate open, FS mechanical ventilation



Layer Height
MVSA fire
LCAC off, top stern gate open, FS mechanical ventilation



HRR, MVSA/UVSA
MVSA fire
LCAC off, top stern gate open, FS mechanical ventilation



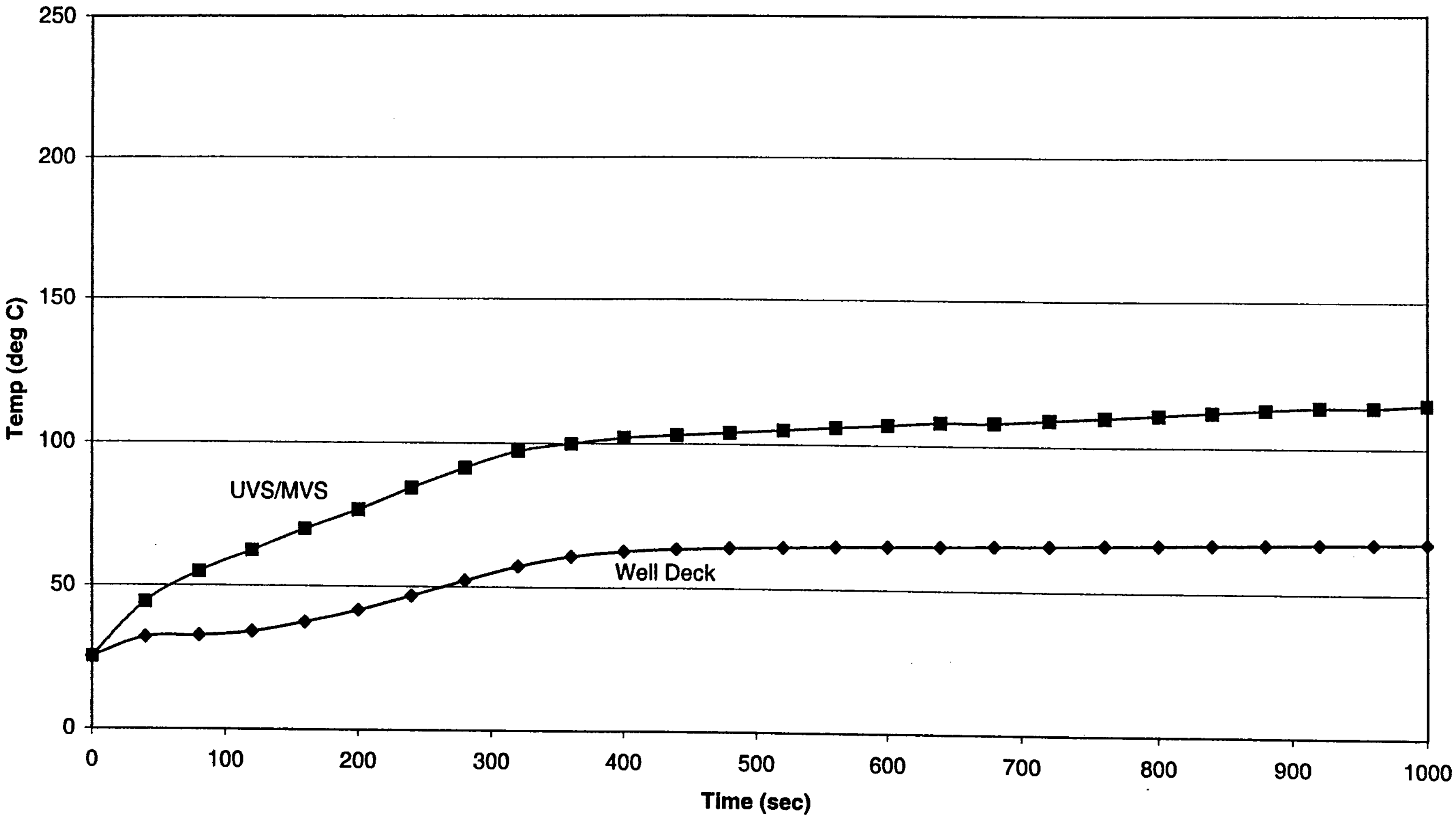
File:	lpd17kkk.in		
TSG:	open	**LCAC:**	supply
BSG:	open	**Fans:**	FS
Fire Location:	MVSA	**Opening:**	2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	31.9	44.3	10.9	10.5	20.4	20.3	0.0	2000.0	0.0	0.0
80.0	32.4	54.9	9.1	9.7	20.3	20.2	0.0	4000.0	0.0	0.0
120.0	33.9	62.4	6.9	8.8	20.3	20.0	0.0	5999.0	0.0	0.0
160.0	37.3	70.1	5.7	8.1	20.3	19.9	0.0	7999.0	0.0	0.0
200.0	41.7	76.8	5.3	7.4	20.2	19.8	0.0	9999.0	0.0	0.0
240.0	46.8	84.4	5.3	6.9	20.1	19.6	0.0	12000.0	0.0	0.0
280.0	52.2	91.3	5.3	6.4	20.0	19.5	0.0	14000.0	0.0	0.0
320.0	57.3	97.3	5.3	6.2	20.0	19.5	0.0	15000.0	0.0	0.0
360.0	60.8	100.0	5.3	6.0	19.9	19.4	0.0	15000.0	0.0	0.0
400.0	62.7	102.0	5.3	6.0	19.9	19.4	0.0	15000.0	0.0	0.0
440.0	63.6	103.0	5.3	6.0	19.9	19.4	0.0	15000.0	0.0	0.0
480.0	64.2	104.0	5.3	6.1	19.9	19.4	0.0	15000.0	0.0	0.0
520.0	64.6	105.0	5.4	6.1	19.8	19.3	0.0	15000.0	0.0	0.0
560.0	64.9	106.0	5.4	6.1	19.8	19.3	0.0	15000.0	0.0	0.0
600.0	65.2	107.0	5.4	6.2	19.8	19.3	0.0	15000.0	0.0	0.0
640.0	65.4	108.0	5.5	6.2	19.8	19.3	0.0	15000.0	0.0	0.0
680.0	65.7	108.0	5.5	6.3	19.8	19.3	0.0	15000.0	0.0	0.0
720.0	65.9	109.0	5.5	6.3	19.8	19.3	0.0	15000.0	0.0	0.0
760.0	66.2	110.0	5.5	6.4	19.8	19.3	0.0	15000.0	0.0	0.0
800.0	66.4	111.0	5.6	6.4	19.8	19.3	0.0	15000.0	0.0	0.0
840.0	66.7	112.0	5.6	6.5	19.8	19.3	0.0	15000.0	0.0	0.0
880.0	66.9	113.0	5.6	6.5	19.8	19.3	0.0	15000.0	0.0	0.0
920.0	67.2	114.0	5.7	6.5	19.8	19.3	0.0	15000.0	0.0	0.0
960.0	67.4	114.0	5.7	6.6	19.8	19.3	0.0	15000.0	0.0	0.0
1000.0	67.6	115.0	5.8	6.6	19.8	19.2	0.0	15000.0	0.0	0.0

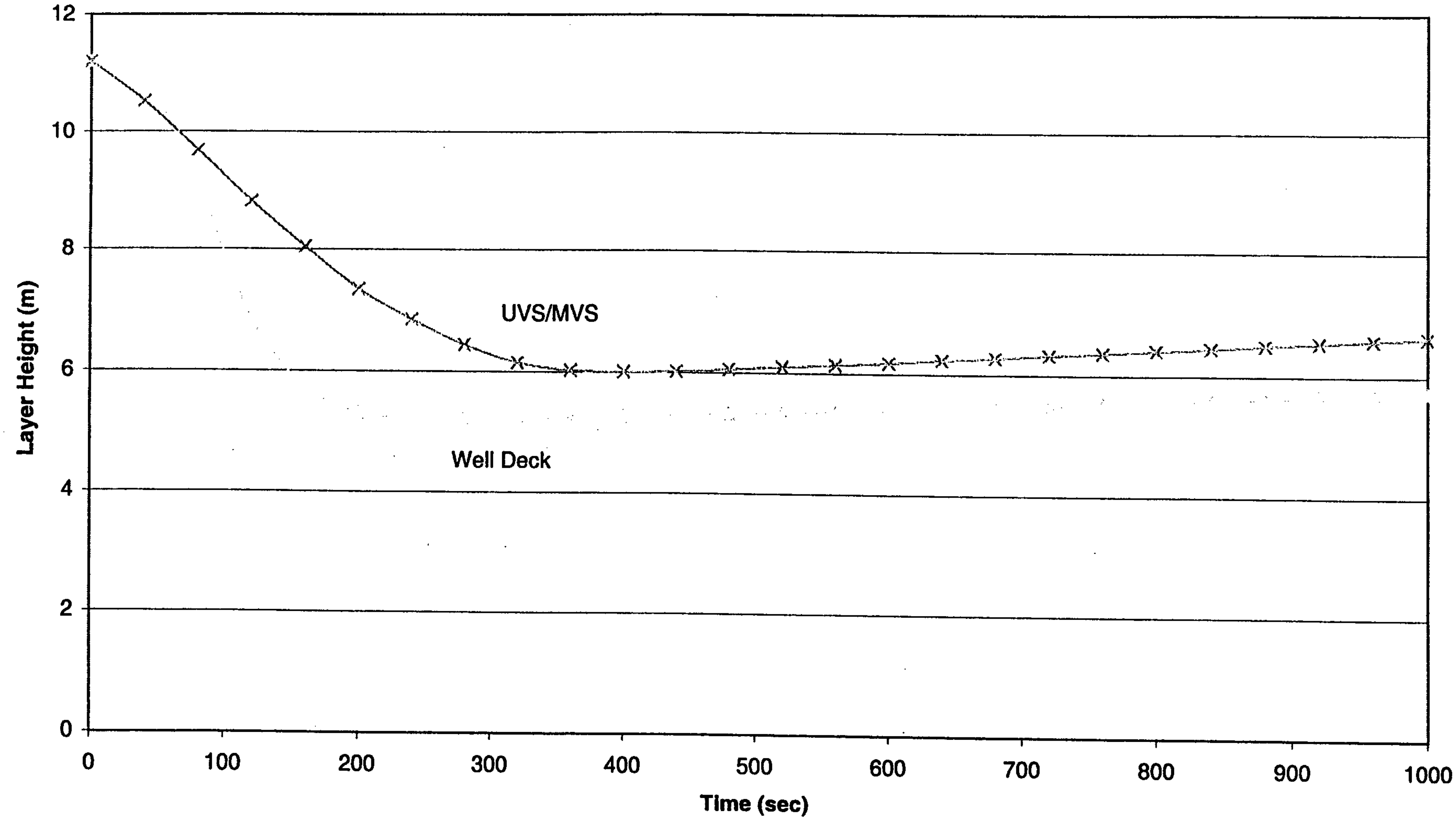
```
VERSN    3  Scenario 32
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.2  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   8.2  4.0
MVOPN  2  12 V  8.2  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  11 10   0.0  1000. 90
MVFAN  15 14   0.0  1000. 90
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   11.2  10   11.2  11  11.2  12   11.2
INELV    13   11.2  14   11.2  15  11.2  16   11.2
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
```

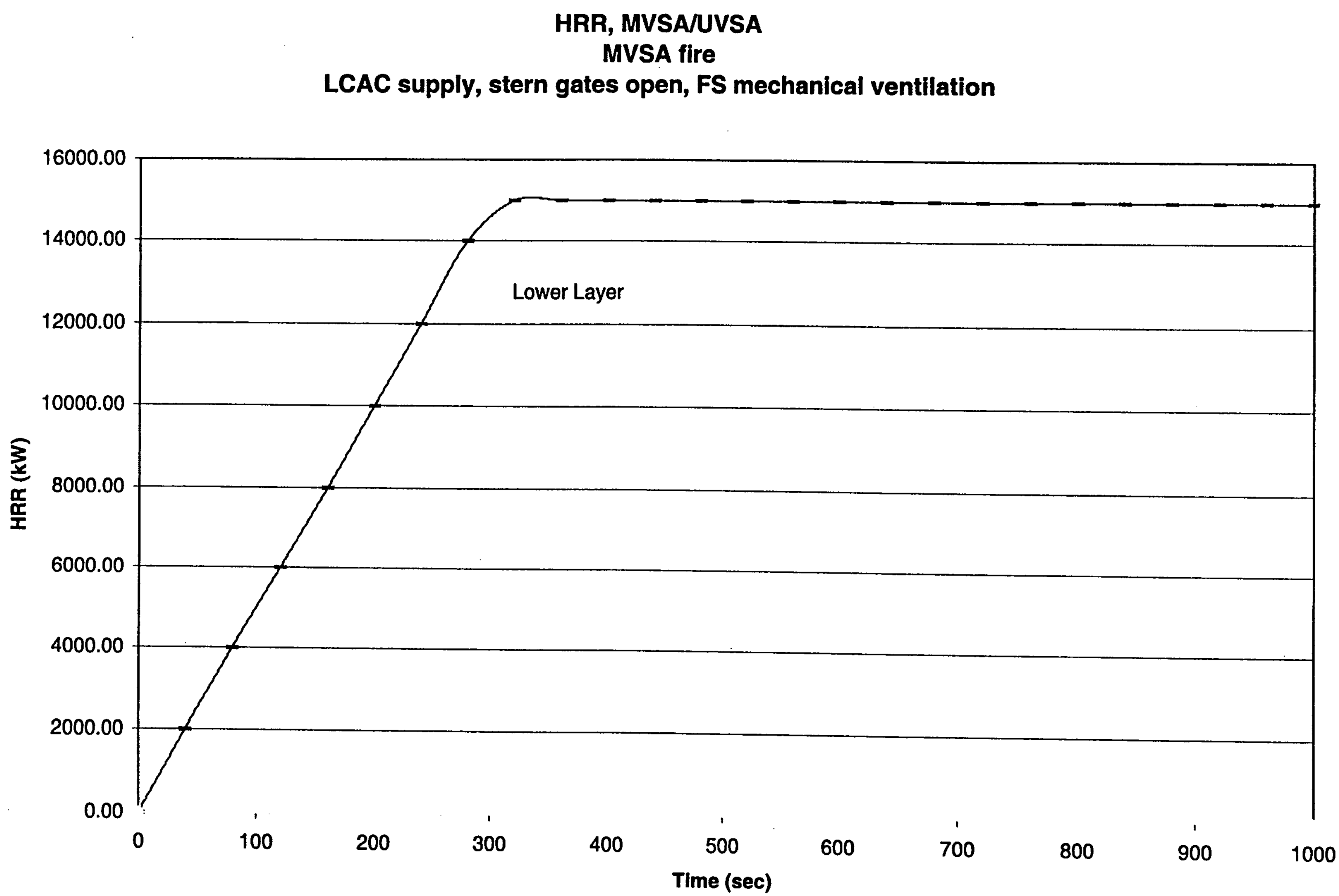
```
CJET OFF
HCR    0.3 0.3
STPMAX  1.00
DUMPR lpd17kkk.hi
DEVICE 1
WINDOW        0      0   -100   1280   1024    1100
GRAPH   1  120.  300.     0.   600.   920.    10. 5 TIME   METERS
GRAPH   2  740.  300.     0.   1220.  920.    10. 5 TIME   CELSIUS
INTER   0 0 0 0 1    1 U
TEMPERA 0 0 0 0 2    1 U
TEMPERA 0 0 0 0 2    1 L
TEMPERA 0 0 0 0 2    2 L
```

Upper Layer Temperature
MVSA fire
LCAC supply, stern gates open, FS mechanical ventilation



Layer Height
MVSA fire
LCAC supply, stern gates open, FS mechanical ventilation




HRR, MVSA/UVSA
MVSA fire
LCAC supply, stern gates open, FS mechanical ventilation
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
HRR (kW)
Lower Layer
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)

File: lpd17lll.in
TSG: open
BSG: closed
Fire Location: MVSA

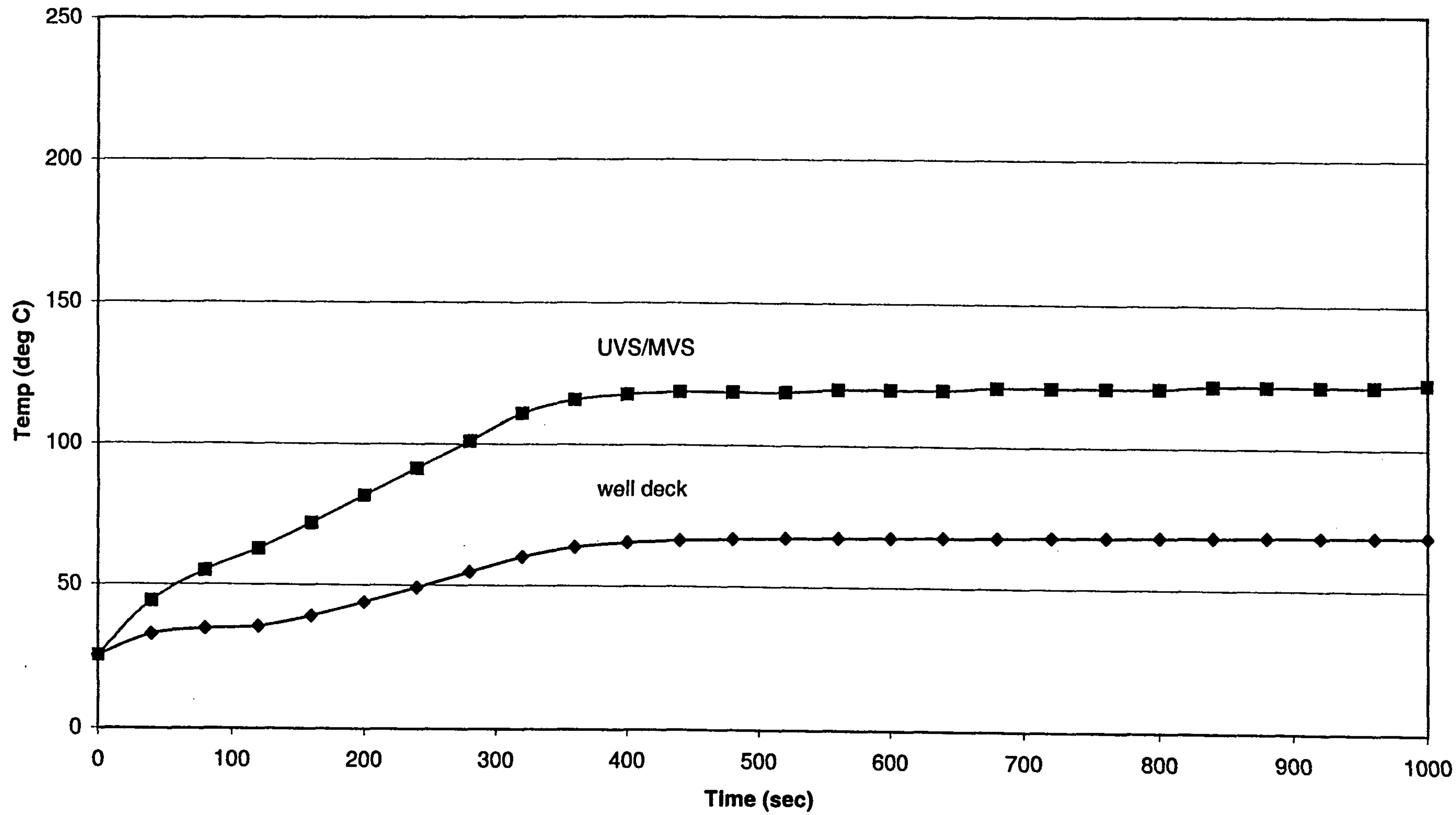
LCAC: supply
Fans: FS
Opening: 2.8 x 5.0

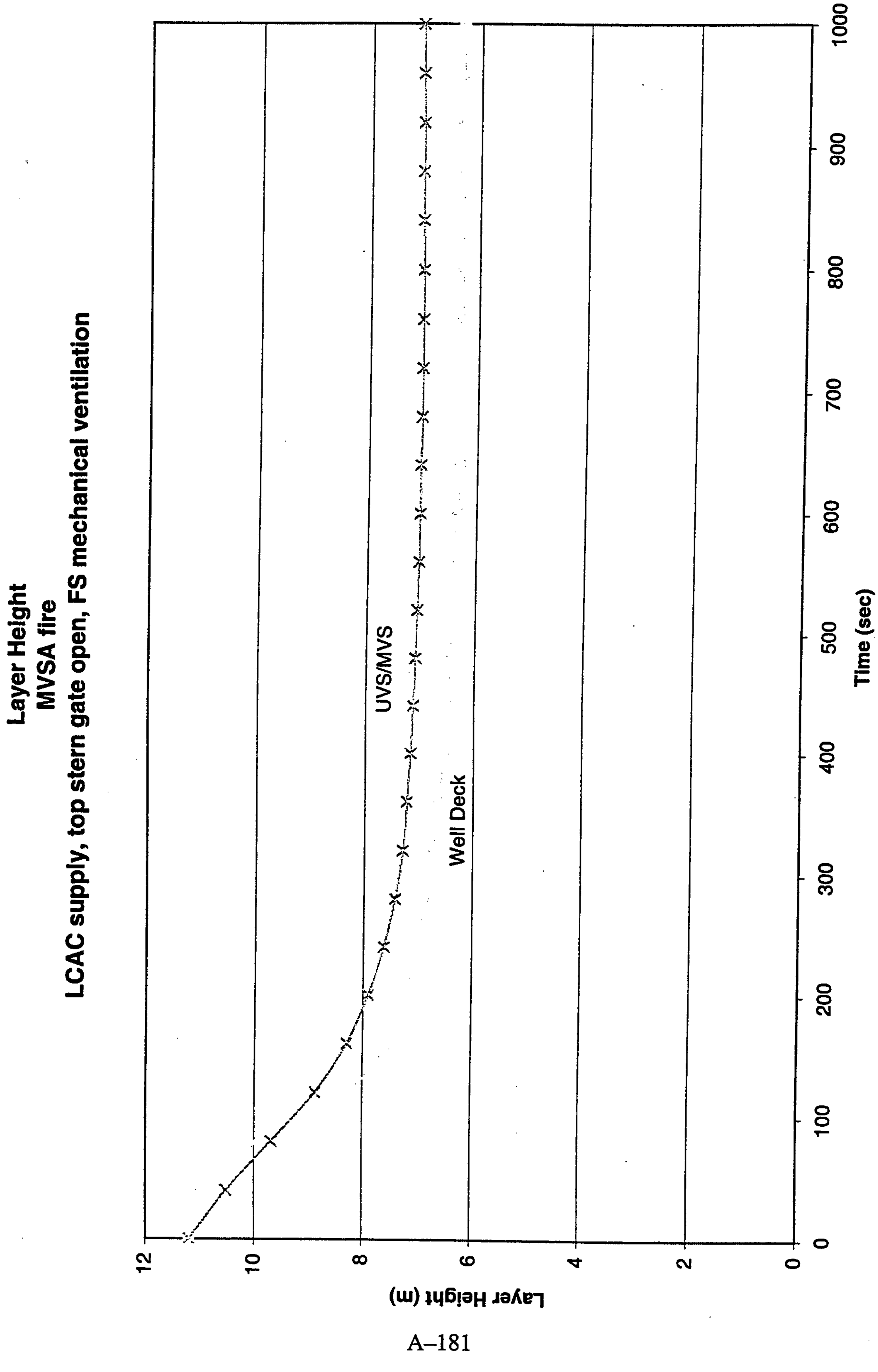
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	32.4	44.3	11.0	10.5	20.4	20.3	0.0	2000.0	0.0	0.0
80.0	34.4	55.0	9.9	9.7	20.3	20.2	0.0	4000.0	0.0	0.0
120.0	35.2	62.7	8.3	8.9	20.3	20.0	0.0	5999.0	0.0	0.0
160.0	39.0	71.8	7.6	8.3	20.2	19.8	0.0	7999.0	0.0	0.0
200.0	43.9	81.6	7.2	7.9	20.2	19.7	0.0	9999.0	0.0	0.0
240.0	49.2	91.4	7.0	7.6	20.1	19.5	0.0	12000.0	0.0	0.0
280.0	54.7	101.0	6.9	7.4	20.0	19.4	0.0	14000.0	0.0	0.0
320.0	60.1	111.0	6.7	7.3	19.9	19.3	0.0	15000.0	0.0	0.0
360.0	63.6	116.0	6.6	7.2	19.9	19.2	0.0	15000.0	0.0	0.0
400.0	65.3	118.0	6.6	7.2	19.8	19.2	0.0	15000.0	0.0	0.0
440.0	66.2	119.0	6.5	7.1	19.8	19.1	0.0	15000.0	0.0	0.0
480.0	66.7	119.0	6.5	7.1	19.8	19.1	0.0	15000.0	0.0	0.0
520.0	67.1	119.0	6.4	7.1	19.8	19.1	0.0	15000.0	0.0	0.0
560.0	67.3	120.0	6.4	7.1	19.8	19.1	0.0	15000.0	0.0	0.0
600.0	67.5	120.0	6.4	7.0	19.8	19.1	0.0	15000.0	0.0	0.0
640.0	67.7	120.0	6.3	7.0	19.8	19.1	0.0	15000.0	0.0	0.0
680.0	67.8	121.0	6.3	7.0	19.8	19.1	0.0	15000.0	0.0	0.0
720.0	68.0	121.0	6.3	7.0	19.8	19.1	0.0	15000.0	0.0	0.0
760.0	68.1	121.0	6.3	7.0	19.8	19.1	0.0	15000.0	0.0	0.0
800.0	68.3	121.0	6.3	7.0	19.8	19.1	0.0	15000.0	0.0	0.0
840.0	68.4	122.0	6.3	7.0	19.8	19.1	0.0	15000.0	0.0	0.0
880.0	68.6	122.0	6.3	7.1	19.8	19.1	0.0	15000.0	0.0	0.0
920.0	68.7	122.0	6.3	7.1	19.8	19.1	0.0	15000.0	0.0	0.0
960.0	68.8	122.0	6.3	7.1	19.8	19.1	0.0	15000.0	0.0	0.0
1000.0	69.0	123.0	6.3	7.1	19.8	19.1	0.0	15000.0	0.0	0.0

```
VERSN    3  Scenario 33
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.2  6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   8.2  4.0
MVOPN  2  12 V  8.2  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  11 10   0.0  1000. 90
MVFAN  15 14   0.0  1000. 90
INELV    1   10.0  2    10.0  3  10.0   4    10.0
INELV    5   6.0  6    6.0  7  6.0   8    6.0
INELV    9   11.2  10   11.2  11  11.2  12   11.2
INELV    13   11.2  14   11.2  15  11.2  16   11.2
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
```

```
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17111.hi
DEVICE 1
WINDOW        0      0   -100   1280   1024    1100
GRAPH    1  120.   300.     0.   600.   920.    10. 5 TIME   METERS
GRAPH    2  740.   300.     0.  1220.   920.    10. 5 TIME   CELSIUS
INTER    0 0 0 0 1    1 U
TEMPERA 0 0 0 0 2    1 U
TEMPERA 0 0 0 0 2    1 L
TEMPERA 0 0 0 0 2    2 L
```

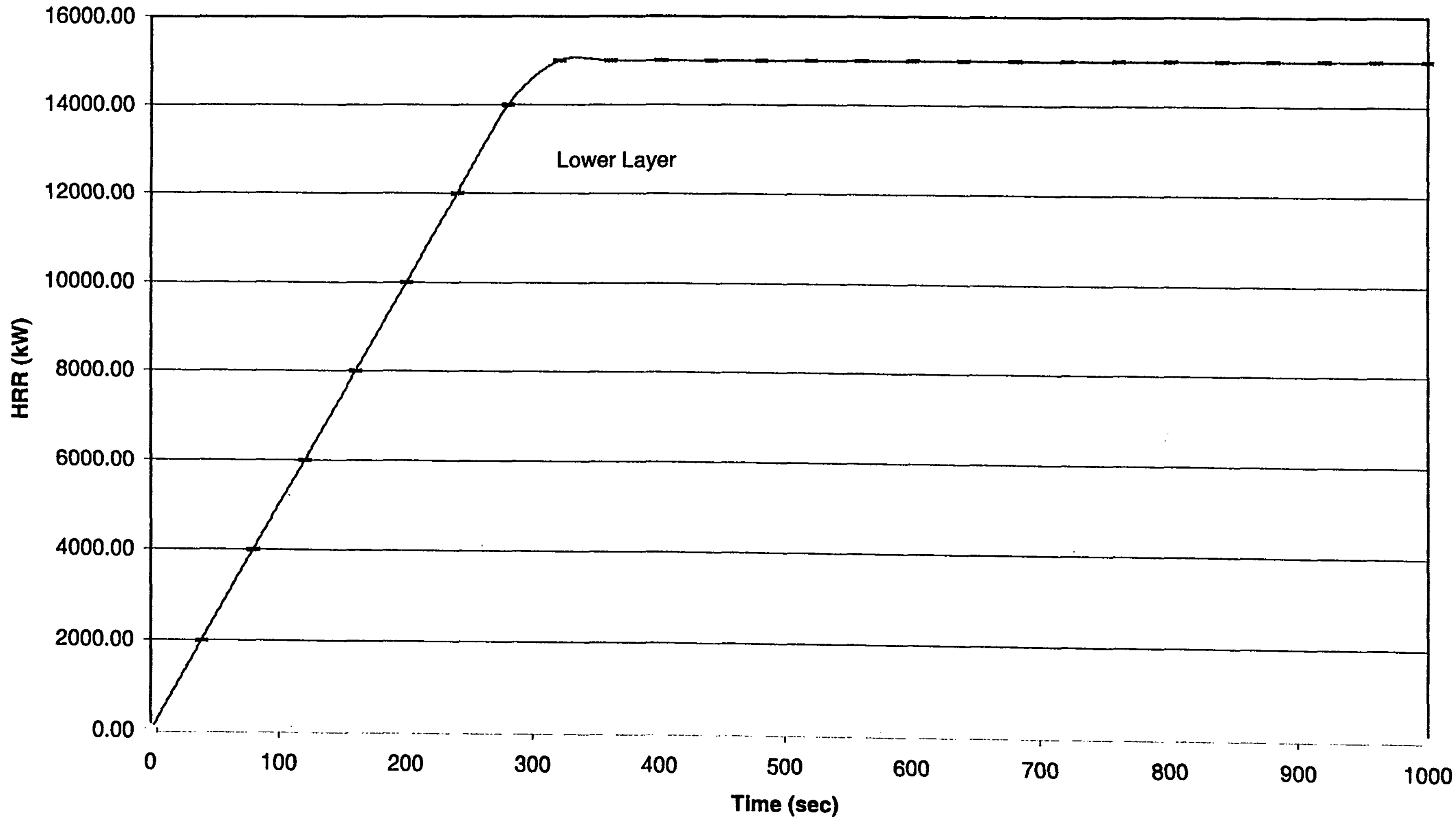
Upper Layer Temperature
MVSA fire
LCAC supply, top stern gate open, FS mechanical ventilation





Layer Height
MVSA fire
LCAC supply, top stern gate open, FS mechanical ventilation
UVS/MVS
Well Deck
Layer Height (m)
Time (sec)
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000

HRR, MVSA/UVSA
MVSA fire
LCAC supply, top stern gate open, FS mechanical ventilation



File: lpd17ppp.in
TSG: closed
BSG: closed
Fire Location: MVSA

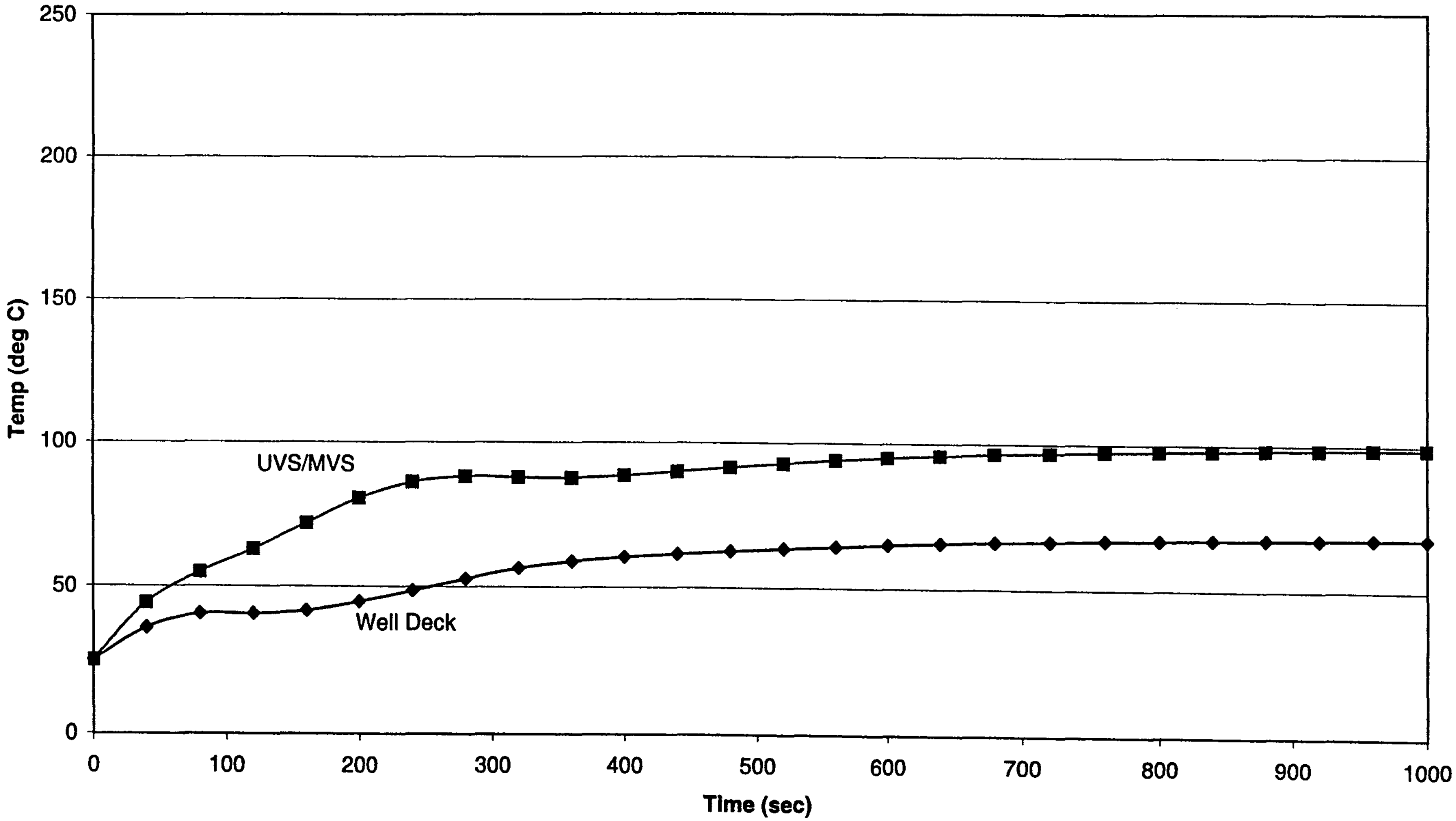
LCAC: exhaust
Fans: FS, AS
Opening: 2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	35.8	44.3	11.1	10.52	20.4	20.3	0	2000	0	0
80	40.6	55	10.5	9.7	20.3	20.2	0	4000	0	0
120	40.6	62.9	9.44	8.96	20.2	20	0	5999	0	0
160	41.7	72	7.93	8.39	20.2	19.8	0	7999	0	0
200	44.8	80.7	6.25	7.77	20.1	19.7	0	9999	0	0
240	48.6	86.1	4.6	6.97	20.1	19.6	0	12000	0	0
280	52.8	88.1	3.32	6.01	20	19.6	0	14000	0	0
320	56.5	87.8	2.19	5	20	19.6	0	15000	0	0
360	58.9	87.7	1.22	4.29	19.9	19.6	0	15000	0	0
400	60.5	88.6	0.63	3.83	19.9	19.6	0	15000	0	0
440	61.6	90	0.33	3.51	19.9	19.5	0	15000	0	0
480	62.6	91.4	0.17	3.3	19.9	19.5	0	15000	0	0
520	63.5	92.8	0.09	3.16	19.9	19.5	0	13060	0	1933
560	64.3	94.1	0.05	3.09	19.8	19.5	0	7391	0	7603
600	65.1	95.1	0.02	3.06	19.8	19.5	0	4790	0	10200
640	65.7	95.9	0.01	3.04	19.8	19.5	0	3386	0	11610
680	66.2	96.6	0.01	3.03	19.8	19.4	0	2540	0	12450
720	66.6	97	0	3.03	19.8	19.4	0	1980	0	13010
760	66.9	97.4	0	3.02	19.8	19.4	0	1581	0	13410
800	67.1	97.8	0	3.02	19.8	19.4	0	1288	0	13700
840	67.4	98	0	3.02	19.8	19.4	0	1067	0	13920
880	67.6	98.3	0	3.02	19.8	19.4	0	897	0	14090
920	67.7	98.5	0	3.02	19.8	19.4	0	763	0	14230
960	67.9	98.7	0	3.02	19.8	19.4	0	655	0	14330
1000	68	98.9	0	3.02	19.8	19.4	0	567	0	14420

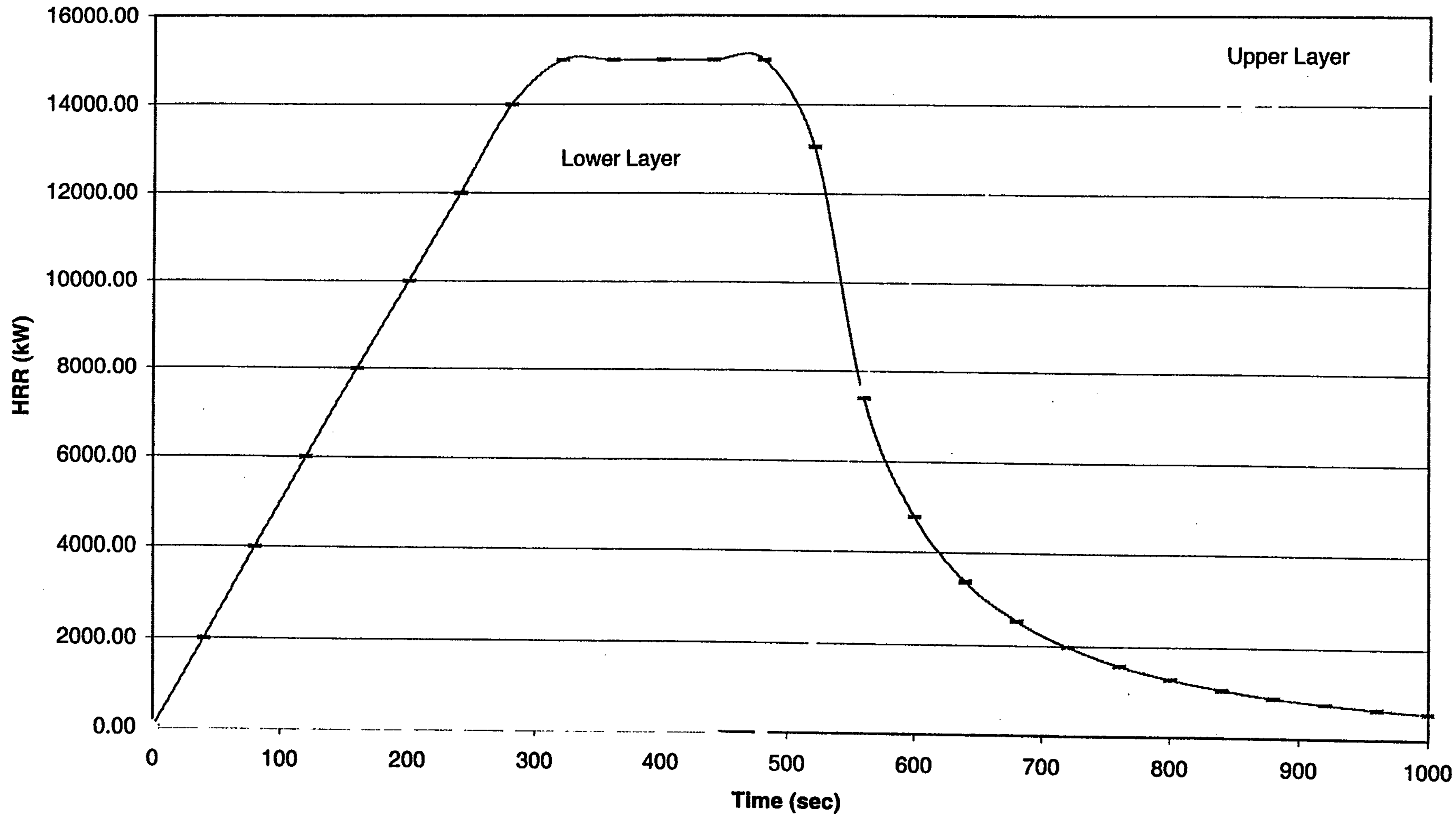
```
VERSN    3  Scenario 34
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   9.0  4.0
MVOPN  2  12 V  9.0  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVOPN  1  17 V   10.0  4.0
MVOPN  3  20 V  10.0  4.0
MVDCT  1  2    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  17 18    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  19 20    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2    0.0  1000. 42.5
MVFAN  7  6    0.0  1000. 42.5
MVFAN  10 11    0.0  1000. 90
MVFAN  14 15    0.0  1000. 90
MVFAN  19 18    0.0  1000. 75
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   12.0  10   12.0  11  12.0  12   12.0
INELV    13   11.2  14   11.2  15  11.2  16   11.2
INELV    17   10.0   18   10.0  19  10.0   20  10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
```

```
FPOS   2.5 2.5 0.0
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17ppp.hi
DEVICE 1
WINDOW        0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

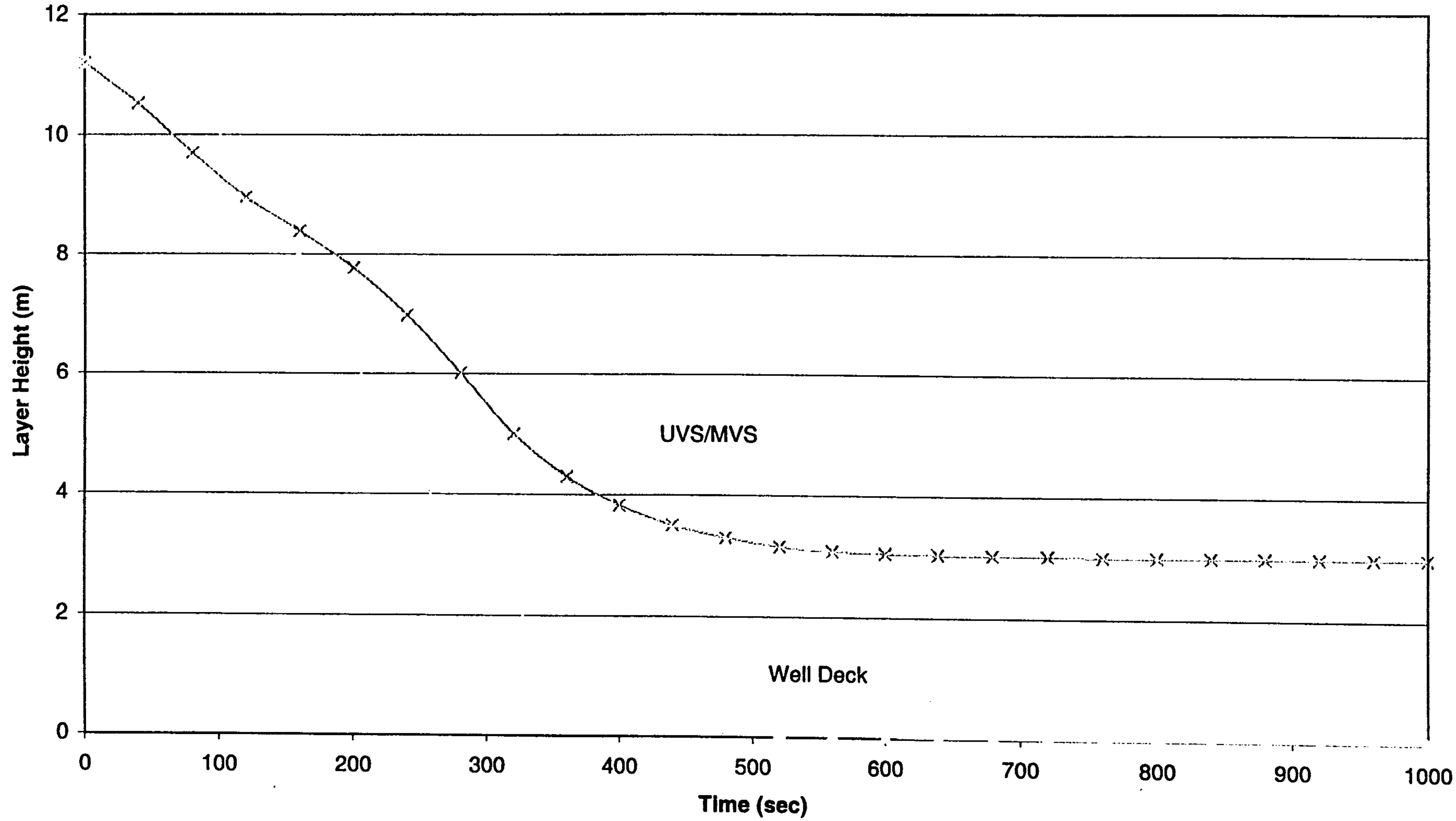
Upper Layer Temperature
MVSA fire
LCAC exhaust (reversed), stern gates closed, FS AS (reversed) mechanical ventilation



HRR, UVSA/MVSA
MVSA fire
LCAC exhaust (reversed), stern gates closed, FS AS (reversed) mechanical ventilation



Layer Height
MVSA fire
LCAC exhaust (reversed), stern gates closed, FS AS (reversed) mechanical ventilation



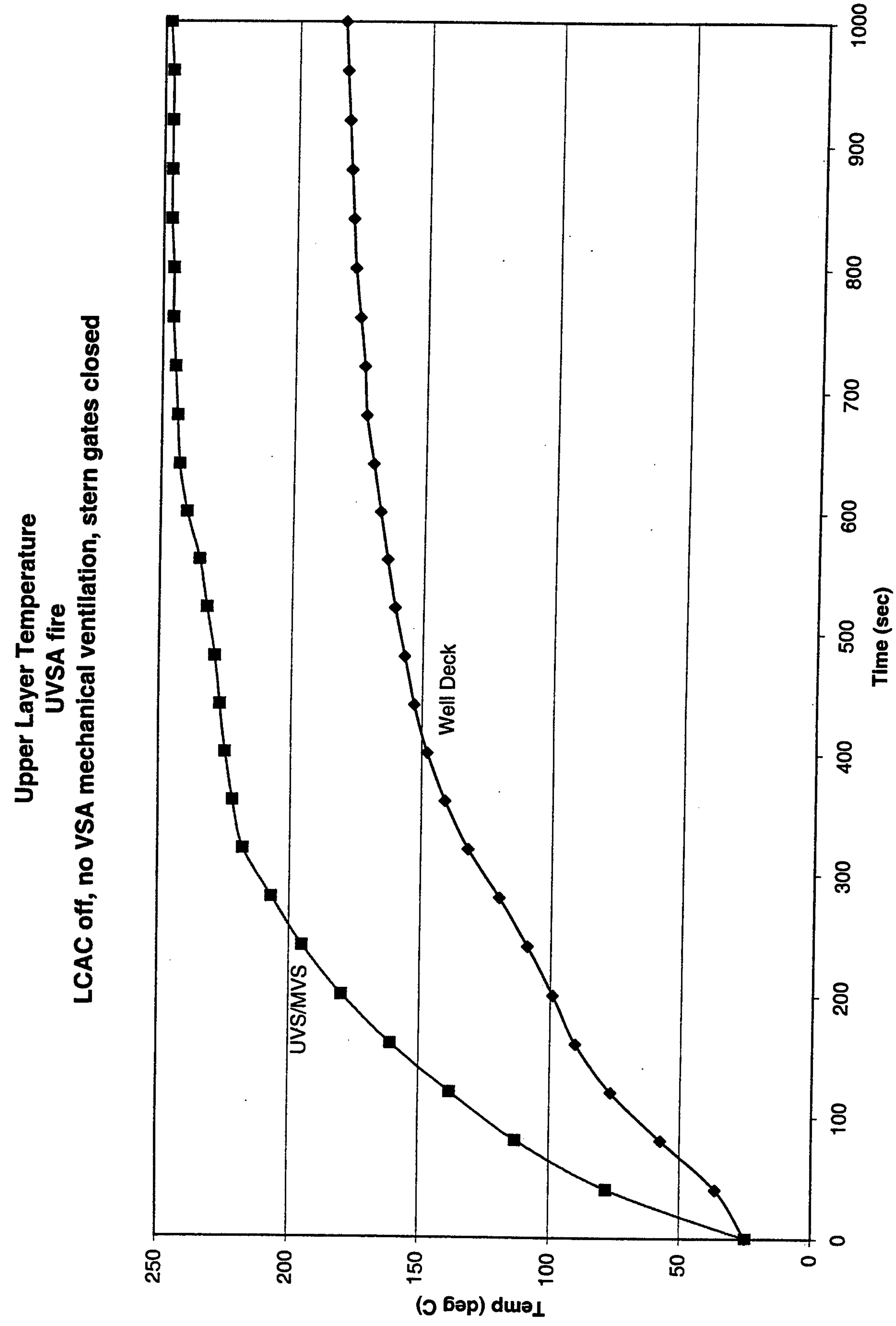
File: lpd17c.in
TSG: closed
BSG: closed
Fire Location: UVSA

LCAC: closed
Fans: no ventilation
Opening: 1' x 1'

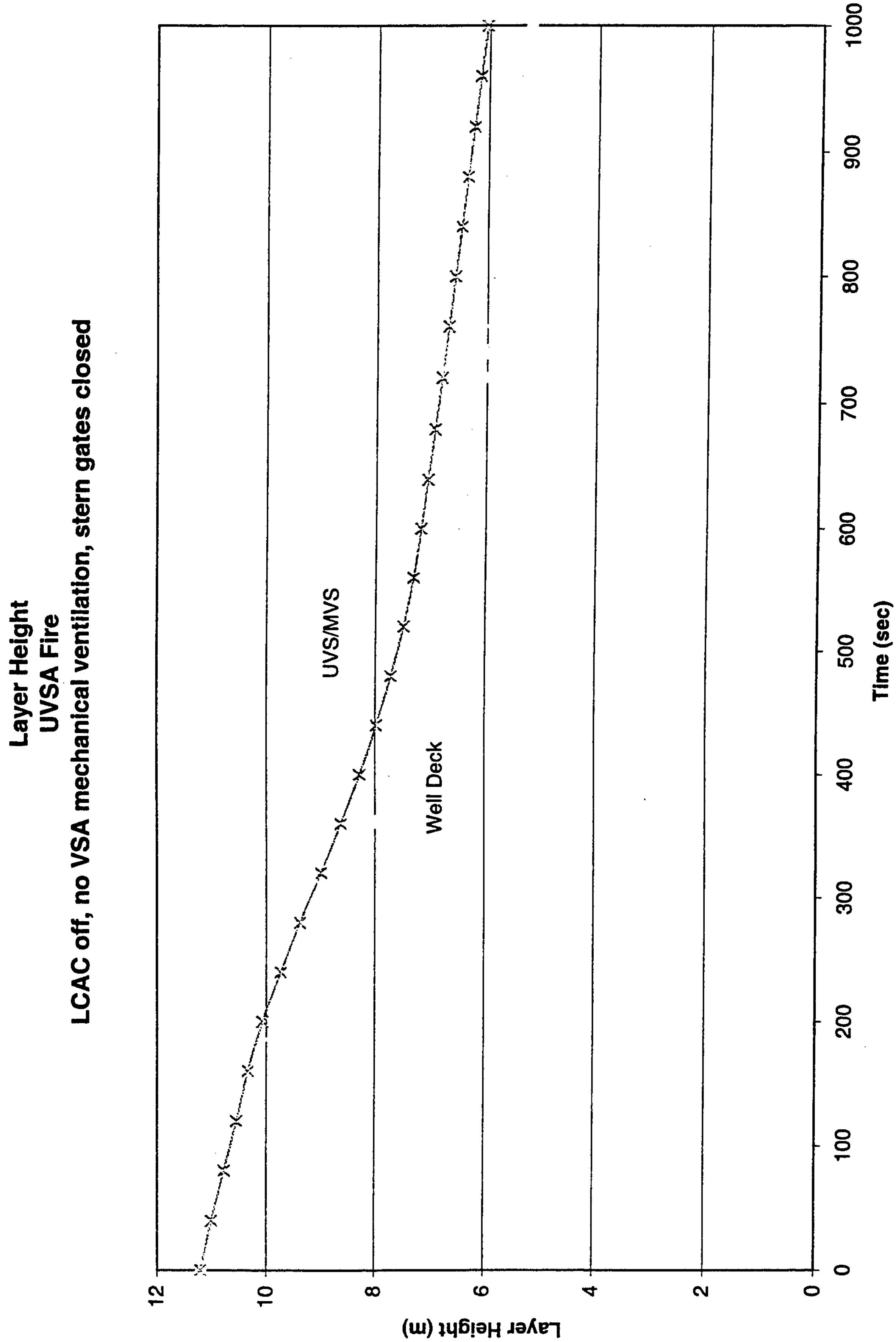
38

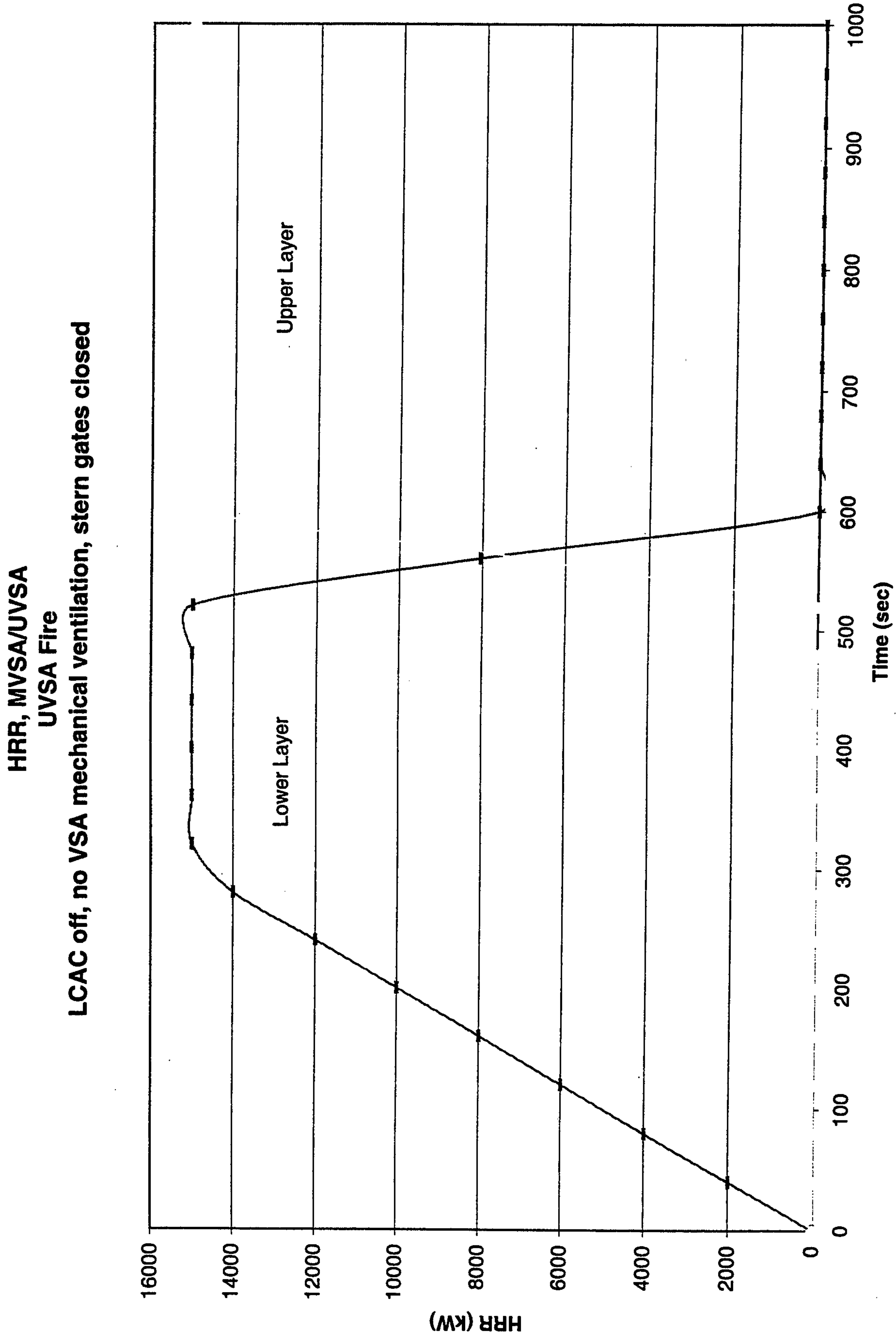
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	36.5	78.0	11.2	11.0	19.9	19.6	0.0	2000.0	0.0	0.0
80.0	57.4	113.0	11.0	10.8	19.4	18.8	0.0	4000.0	0.0	0.0
120.0	76.5	138.0	10.7	10.5	18.9	18.3	0.0	6000.0	0.0	0.0
160.0	90.2	161.0	10.3	10.3	18.5	17.8	0.0	8000.0	0.0	0.0
200.0	99.2	180.0	9.8	10.1	18.2	17.3	0.0	9999.0	0.0	0.0
240.0	109.0	195.0	9.4	9.7	17.9	17.0	0.0	12000.0	0.0	0.0
280.0	120.0	207.0	8.9	9.4	17.5	16.7	0.0	14000.0	0.0	0.0
320.0	132.0	218.0	8.5	9.0	17.2	16.4	0.0	15000.0	0.0	0.0
360.0	141.0	222.0	8.1	8.6	16.9	16.2	0.0	15000.0	0.0	0.0
400.0	148.0	225.0	7.7	8.3	16.7	15.9	0.0	15000.0	0.0	0.0
440.0	153.0	227.0	7.4	8.0	16.4	15.7	0.0	15000.0	0.0	0.0
480.0	157.0	229.0	7.1	7.7	16.1	15.4	0.0	15000.0	0.0	0.0
520.0	161.0	232.0	6.8	7.5	15.9	15.1	0.0	14990.0	0.0	0.0
560.0	164.0	235.0	6.6	7.3	15.6	14.7	0.0	8054.0	0.0	6940.0
600.0	167.0	240.0	6.4	7.2	15.2	14.3	0.0	0.0	0.0	15000.0
640.0	170.0	243.0	6.3	7.1	14.9	13.9	0.0	0.0	0.0	15000.0
680.0	173.0	244.0	6.2	6.9	14.5	13.5	0.0	0.0	0.0	15000.0
720.0	174.0	245.0	6.1	6.8	14.1	13.1	0.0	0.0	0.0	15000.0
760.0	176.0	246.0	5.9	6.7	13.8	12.8	0.0	0.0	0.0	15000.0
800.0	178.0	246.0	5.8	6.6	13.4	12.5	0.0	0.0	0.0	15000.0
840.0	179.0	247.0	5.7	6.5	13.1	12.2	0.0	0.0	0.0	15000.0
880.0	180.0	247.0	5.6	6.4	12.7	11.9	0.0	0.0	0.0	15000.0
920.0	181.0	247.0	5.5	6.3	12.4	11.6	0.0	0.0	0.0	15000.0
960.0	182.0	247.0	5.4	6.2	12.1	11.4	0.0	0.0	0.0	15000.0
1000.0	183.0	248.0	5.2	6.0	11.8	11.1	0.0	0.0	0.0	15000.0

```
VERSN     3  Scenario 35
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   .30 .30 0.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 4.2
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17c.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```



Upper Layer Temperature
UVSA fire
LCAC off, no VSA mechanical ventilation, stern gates closed
Temp (deg C)
Time (sec)
UVS/MVS
Well Deck
0
50
100
150
200
250
0
100
200
300
400
500
600
700
800
900
1000


Layer Height
UVSA Fire
LCAC off, no VSA mechanical ventilation, stern gates closed
UVS/MVS
Well Deck
Layer Height (m)
Time (sec)
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000

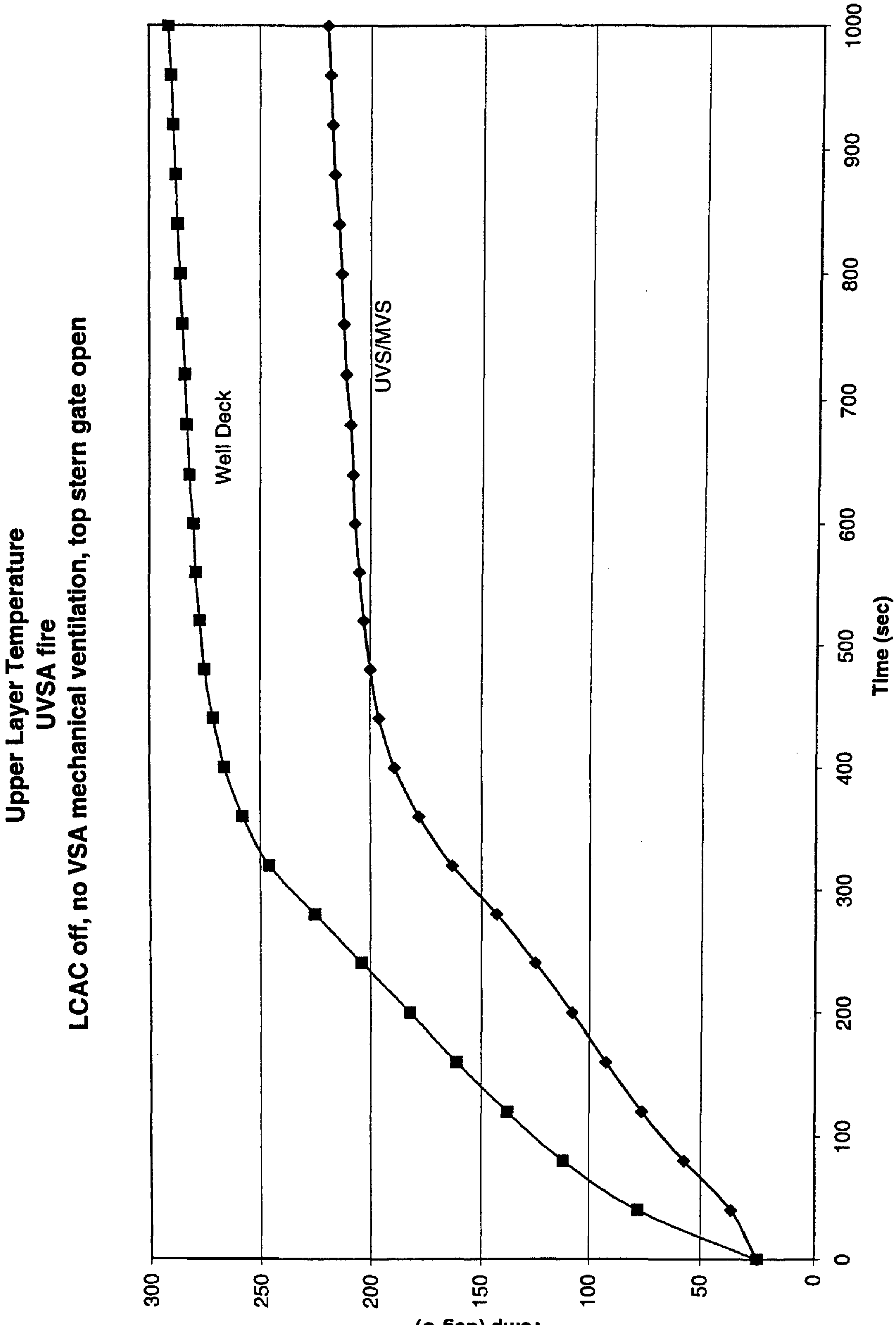

HRR, MVSA/UVSA
UVSA Fire
LCAC off, no VSA mechanical ventilation, stern gates closed
Upper Layer
Lower Layer
HRR (kW)
Time (sec)
0
2000
4000
6000
8000
10000
12000
14000
16000
100
200
300
400
500
600
700
800
900
1000

File: lpd17f.in
TSG: open
BSG: closed
Fire Location: UVSA

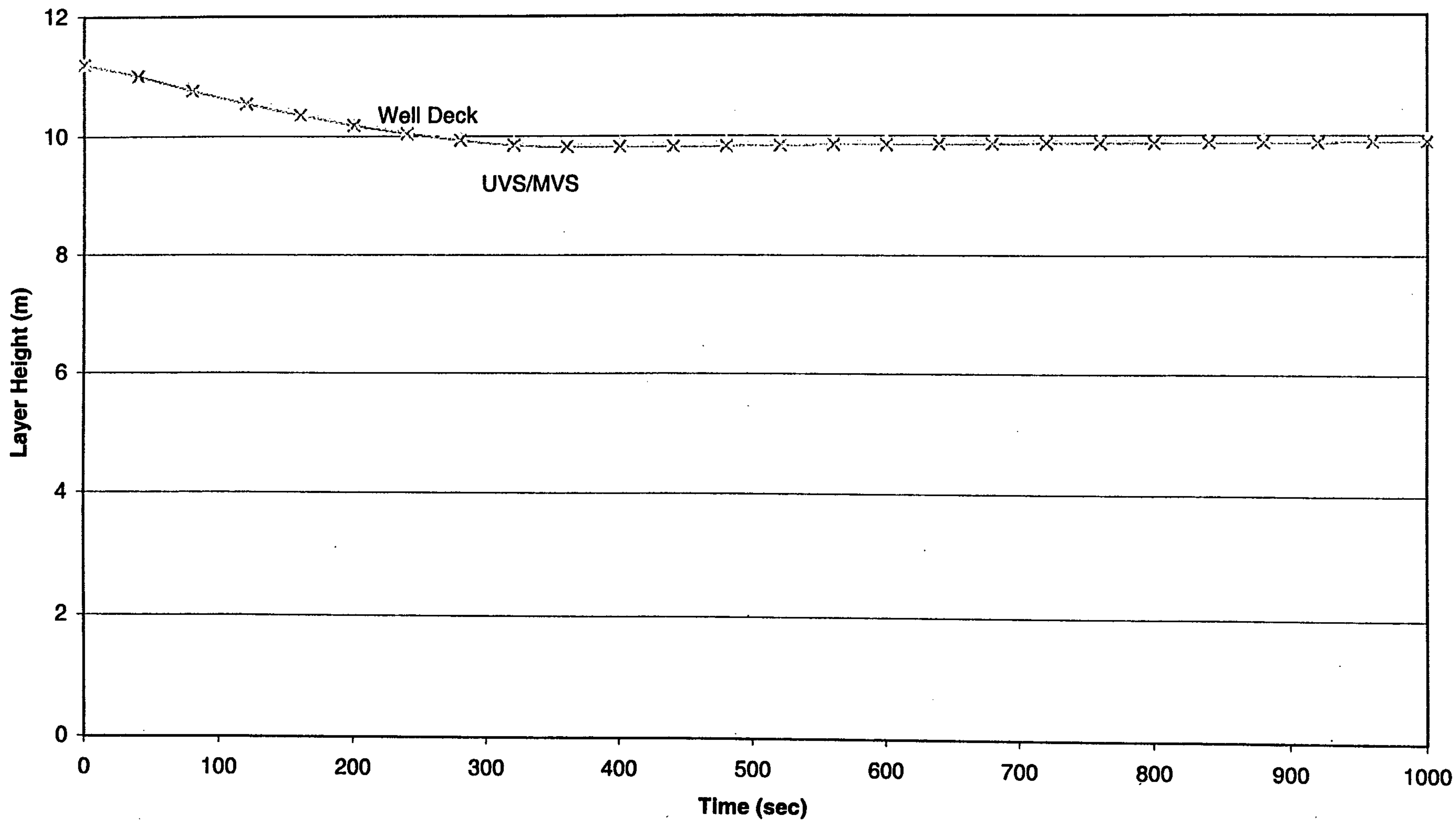
LCAC: off
Fans: no ventilation
Opening: none

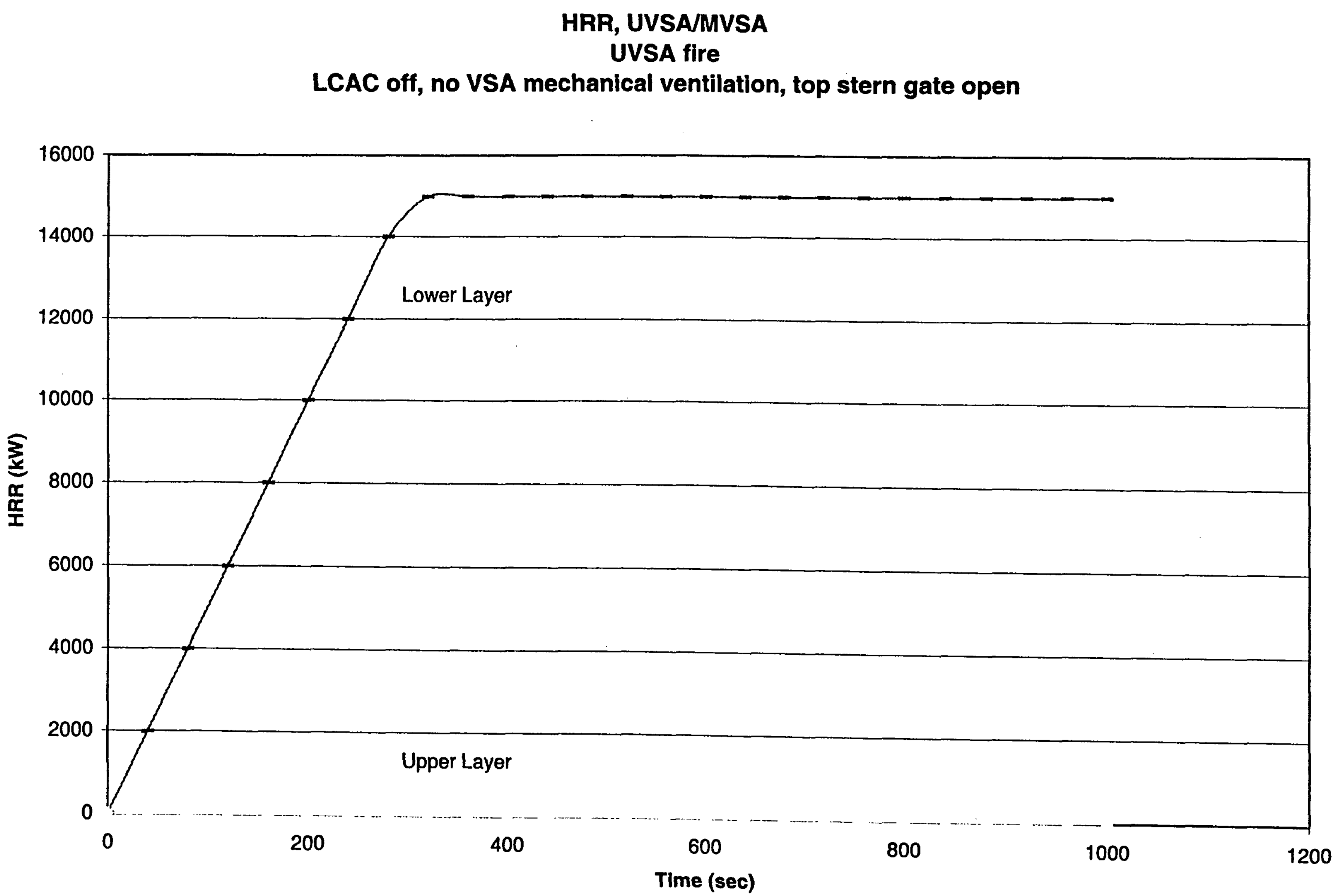
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	36.5	78.0	11.2	11.0	19.9	19.6	0.0	2000.0	0.0	0.0
80.0	57.3	112.0	11.0	10.8	19.4	18.8	0.0	4000.0	0.0	0.0
120.0	76.3	138.0	10.7	10.5	18.9	18.3	0.0	6000.0	0.0	0.0
160.0	92.5	161.0	10.4	10.4	18.4	17.8	0.0	8000.0	0.0	0.0
200.0	108.0	182.0	10.2	10.2	18.0	17.3	0.0	10000.0	0.0	0.0
240.0	125.0	204.0	10.1	10.0	17.5	16.8	0.0	12000.0	0.0	0.0
280.0	143.0	225.0	10.0	9.9	17.0	16.4	0.0	14000.0	0.0	0.0
320.0	163.0	246.0	9.9	9.9	16.6	16.1	0.0	15000.0	0.0	0.0
360.0	178.0	258.0	9.9	9.8	16.3	15.9	0.0	15000.0	0.0	0.0
400.0	189.0	266.0	9.9	9.8	16.0	15.8	0.0	15000.0	0.0	0.0
440.0	196.0	271.0	9.9	9.8	15.9	15.8	0.0	15000.0	0.0	0.0
480.0	200.0	275.0	9.9	9.8	15.8	15.8	0.0	15000.0	0.0	0.0
520.0	203.0	277.0	9.9	9.8	15.8	15.8	0.0	15000.0	0.0	0.0
560.0	205.0	279.0	9.9	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
600.0	207.0	280.0	9.9	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
640.0	208.0	282.0	9.9	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
680.0	209.0	283.0	9.9	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
720.0	211.0	284.0	9.9	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
760.0	212.0	285.0	9.9	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
800.0	213.0	286.0	9.9	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
840.0	214.0	287.0	10.0	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
880.0	216.0	288.0	10.0	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
920.0	217.0	289.0	10.0	9.9	15.8	15.8	0.0	15000.0	0.0	0.0
960.0	218.0	290.0	10.0	9.9	15.9	15.8	0.0	15000.0	0.0	0.0
1000.0	219.0	291.0	10.0	9.9	15.9	15.9	0.0	15000.0	0.0	0.0

```
VERSN    3  Scenario 36
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   18.5 11.0  6.8
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 4.2
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17f.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME   METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME   CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```


Upper Layer Temperature
UVSA fire
LCAC off, no VSA mechanical ventilation, top stern gate open
Well Deck
UVS/MVS
Temp (deg C)
Time (sec)
0
50
100
150
200
250
300
0
100
200
300
400
500
600
700
800
900
1000

Layer Height
UVSA fire
LCAC off, no VSA mechanical ventilation, top stern gate open





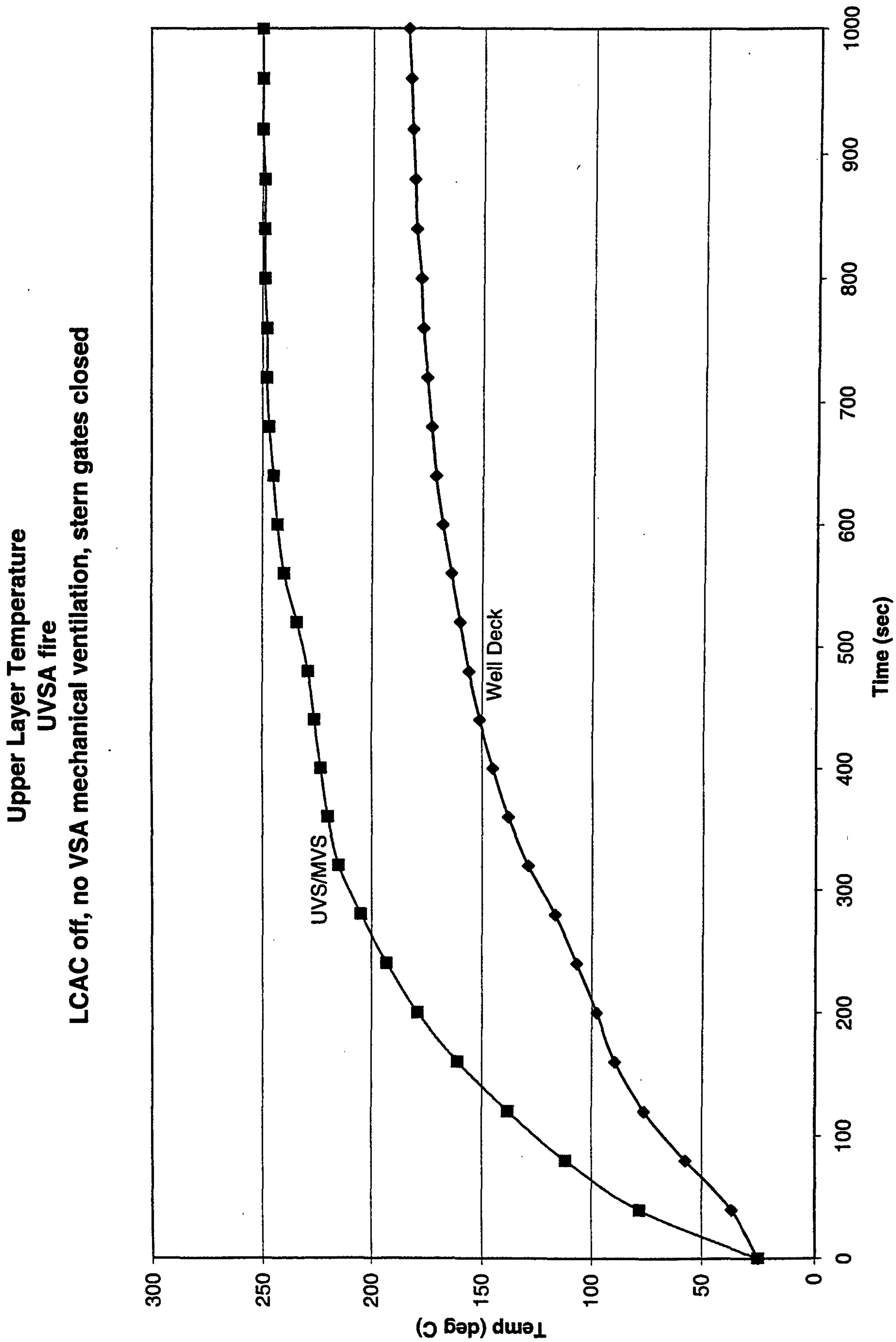
HRR, UVSA/MVSA
UVSA fire
LCAC off, no VSA mechanical ventilation, top stern gate open
HRR (kW)
16000
14000
12000
10000
8000
6000
4000
2000
0
Lower Layer
Upper Layer
0
200
400
600
800
1000
1200
Time (sec)

File: lpd17l.in
TSG: closed
BSG: closed
Fire Location: uvsa

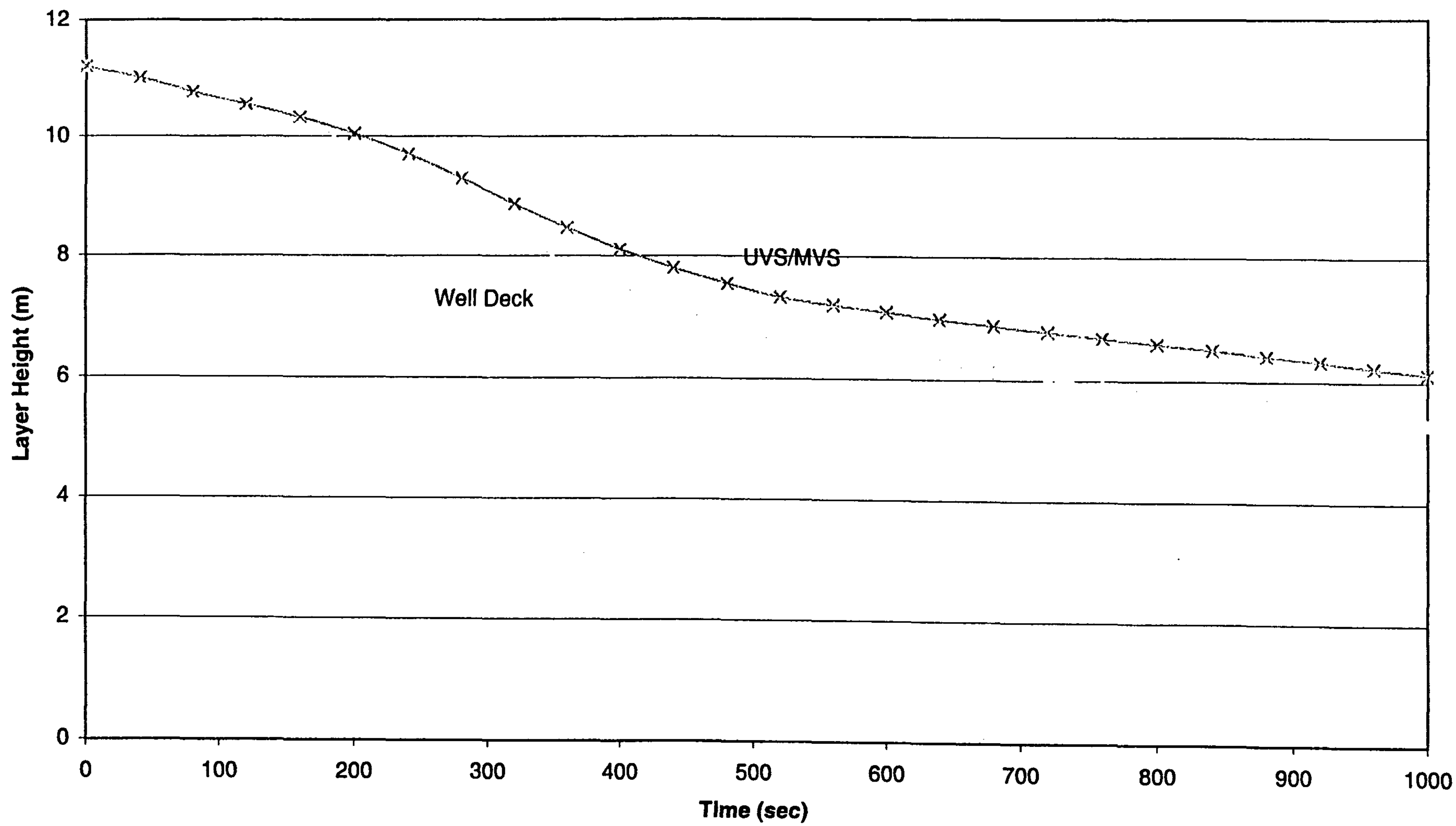
LCAC: off
Fans: no ventilation
Opening: 2.8 x 5.0

Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0	25	25	11.2	11.2	20.6	20.6	0	0	0	0
40	36.5	78	11.2	11	19.9	19.6	0	2000	0	1.492E-13
80	57.3	112	11	10.76	19.4	18.8	0	4000	0	2.984E-13
120	76	138	10.7	10.54	18.9	18.3	0	6000	0	5.967E-13
160	89.3	161	10.3	10.32	18.5	17.8	0	8000	0	5.967E-13
200	97.8	179	9.81	10.04	18.2	17.3	0	10000	0	1.193E-12
240	107	193	9.34	9.7	17.9	17	0	12000	0	1.193E-12
280	117	205	8.85	9.3	17.5	16.6	0	14000	0	1.193E-12
320	129	215	8.33	8.87	17.2	16.4	0	15000	0	1.193E-12
360	138	220	7.88	8.47	16.9	16.1	0	15000	0	1.193E-12
400	145	223	7.49	8.11	16.6	15.8	0	15000	0	1.193E-12
440	151	226	7.15	7.8	16.3	15.6	0	15000	0	1.193E-12
480	156	229	6.86	7.54	16	15.2	0	15000	0	1.193E-12
520	160	234	6.62	7.33	15.7	14.8	0	10030	0	4968
560	164	240	6.46	7.2	15.4	14.3	0	0	0	15000
600	168	243	6.34	7.09	15	13.9	0	0	0	15000
640	171	245	6.23	6.98	14.6	13.5	0	0	0	15000
680	173	247	6.13	6.88	14.2	13.1	0	0	0	15000
720	175	248	6.03	6.79	13.8	12.7	0	0	0	15000
760	177	248	5.93	6.69	13.4	12.4	0	0	0	15000
800	178	249	5.83	6.6	13	12.1	0	0	0	15000
840	180	249	5.73	6.51	12.7	11.8	0	0	0	15000
880	181	249	5.62	6.41	12.3	11.5	0	0	0	15000
920	182	250	5.52	6.32	12	11.2	0	0	0	15000
960	183	250	5.42	6.22	11.7	10.9	0	0	0	15000
1000	184	250	5.31	6.12	11.4	10.7	0	0	0	15000

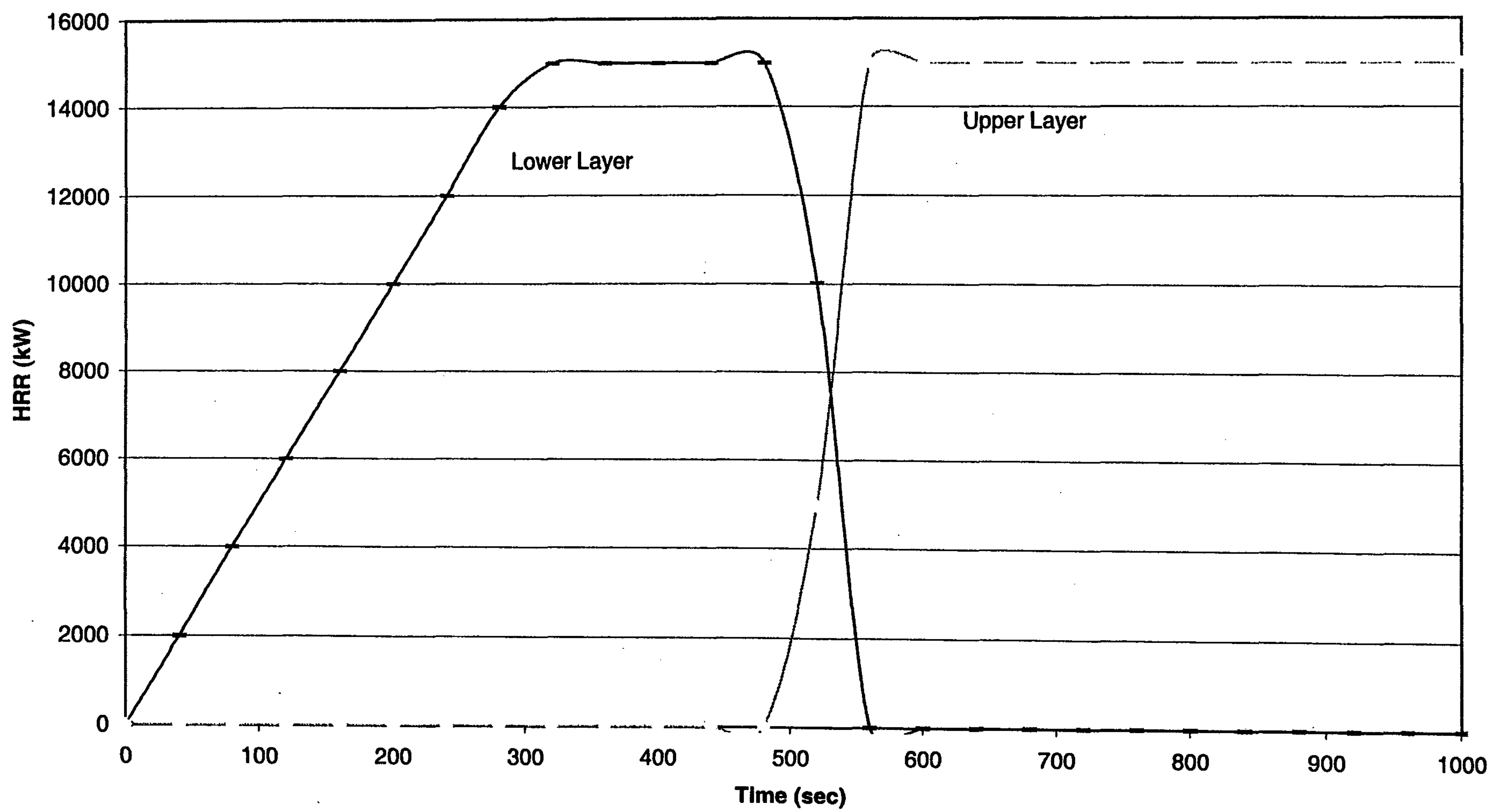
```
VERSN    3  Scenario 37
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 4.2
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd171.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```


Upper Layer Temperature
UVSA fire
LCAC off, no VSA mechanical ventilation, stern gates closed
UVS/MVS
Well Deck
Temp (deg C)
300
250
200
150
100
50
0
Time (sec)
0
100
200
300
400
500
600
700
800
900
1000

Layer Height
UVSA fire
LCAC off, no VSA mechanical ventilation, stern gates closed



HRR, UVSA/MVSA
UVSA Fire
LCAC off, no VSA mechanical ventilation, stern gates closed



File: lpd17aa.in
TSG: closed
BSG: closed
Fire Location: uvsa

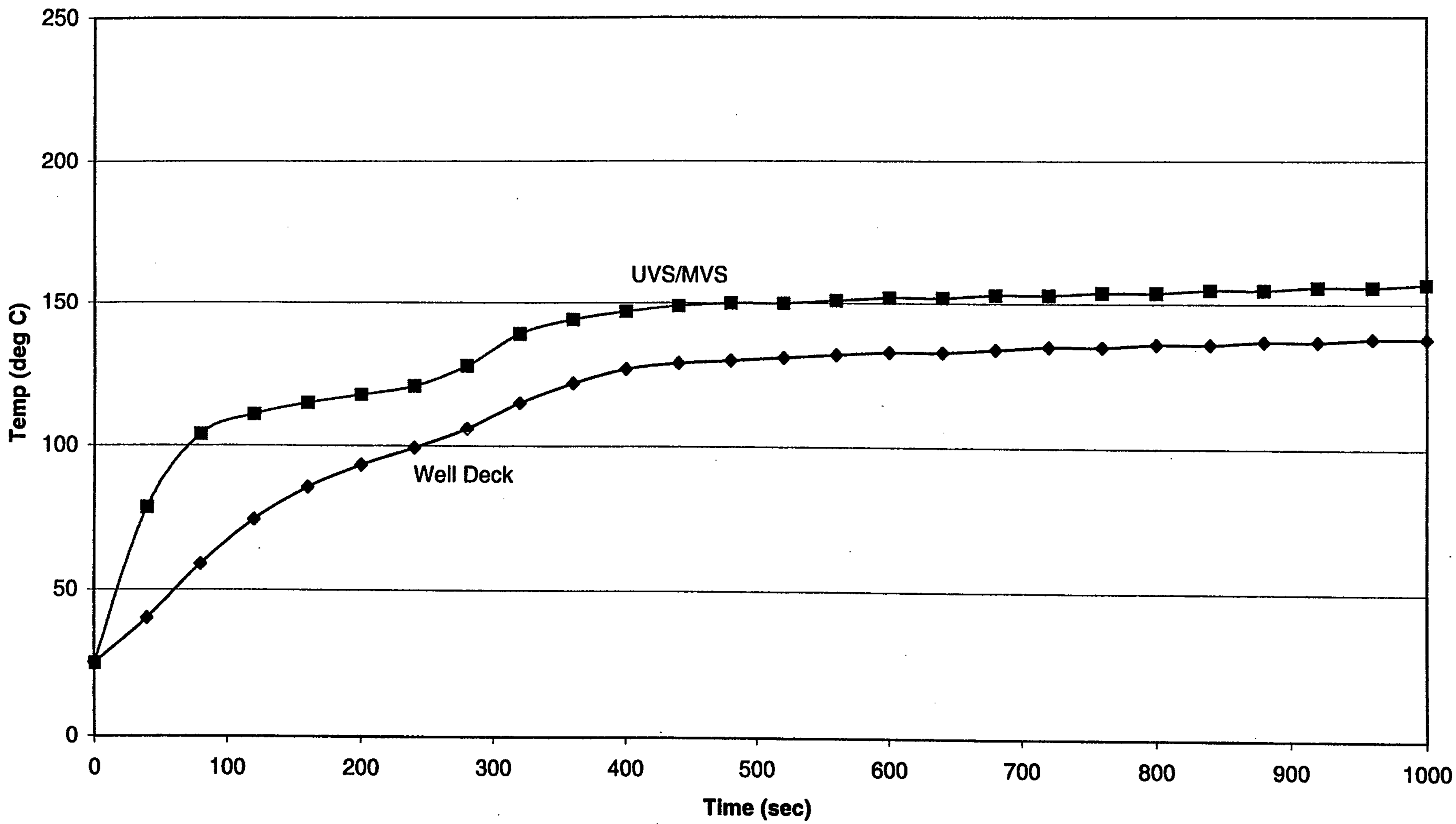
LCAC: off
Fans: FS, AE
Opening: 2.8 x 5.0

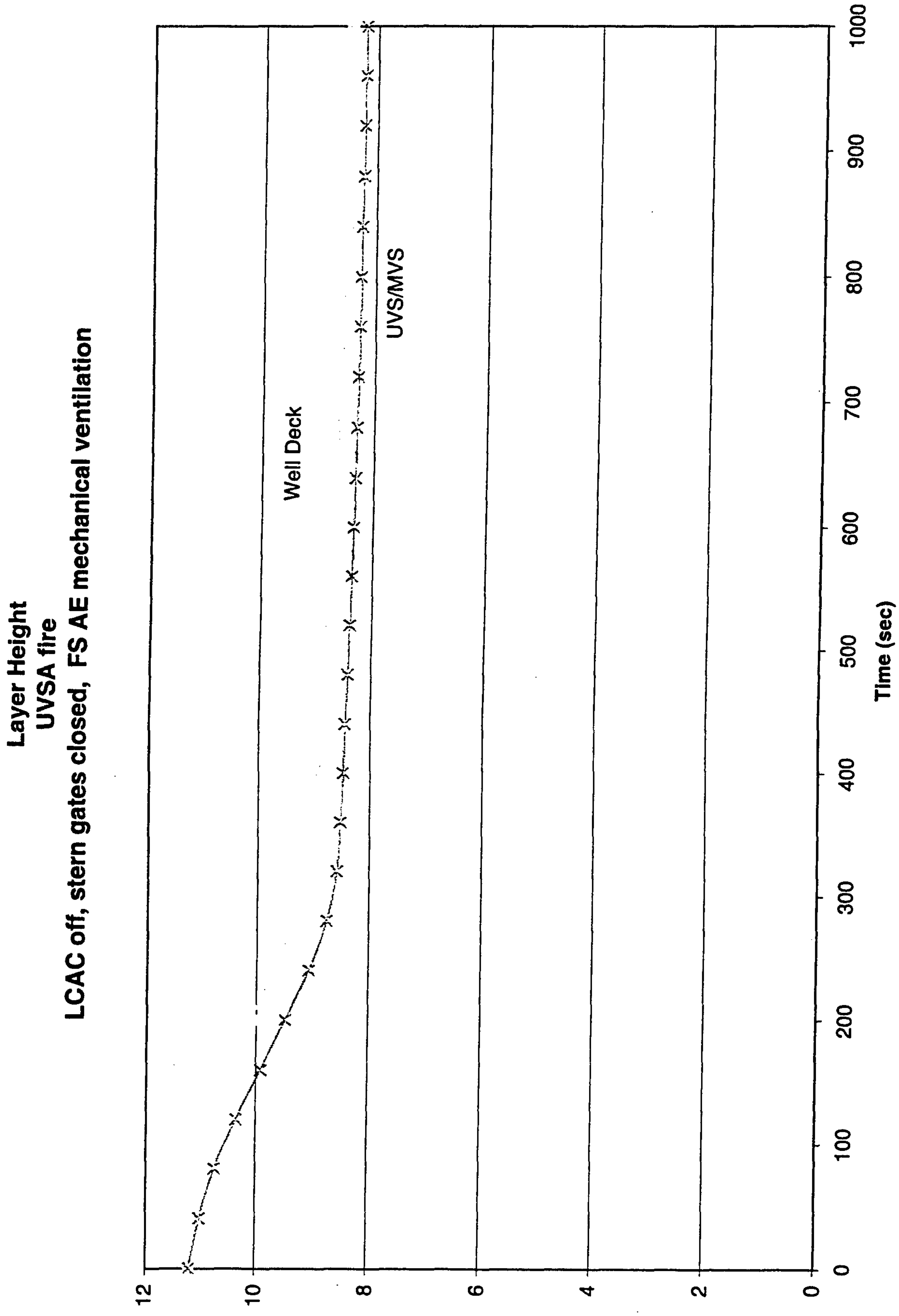
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	40.2	78.7	11.2	11.0	19.9	19.5	0.0	2000.0	0.0	0.0
80.0	59.0	104.0	11.0	10.8	19.4	19.0	0.0	4000.0	0.0	0.0
120.0	74.6	111.0	10.7	10.4	19.1	18.9	0.0	6000.0	0.0	0.0
160.0	85.8	115.0	10.4	9.9	19.1	18.9	0.0	8000.0	0.0	0.0
200.0	93.5	118.0	10.1	9.5	19.1	19.0	0.0	10000.0	0.0	0.0
240.0	99.4	121.0	9.7	9.1	19.1	19.0	0.0	12000.0	0.0	0.0
280.0	106.0	128.0	9.3	8.8	19.0	18.9	0.0	14000.0	0.0	0.0
320.0	115.0	139.0	9.1	8.6	18.9	18.8	0.0	15000.0	0.0	0.0
360.0	122.0	144.0	9.0	8.5	18.8	18.7	0.0	15000.0	0.0	0.0
400.0	127.0	147.0	8.9	8.5	18.8	18.7	0.0	15000.0	0.0	0.0
440.0	129.0	149.0	8.9	8.5	18.7	18.7	0.0	15000.0	0.0	0.0
480.0	130.0	150.0	8.8	8.4	18.7	18.7	0.0	15000.0	0.0	0.0
520.0	131.0	150.0	8.8	8.4	18.7	18.6	0.0	15000.0	0.0	0.0
560.0	132.0	151.0	8.7	8.4	18.7	18.6	0.0	15000.0	0.0	0.0
600.0	133.0	152.0	8.7	8.4	18.7	18.6	0.0	15000.0	0.0	0.0
640.0	133.0	152.0	8.7	8.3	18.7	18.6	0.0	15000.0	0.0	0.0
680.0	134.0	153.0	8.6	8.3	18.7	18.6	0.0	15000.0	0.0	0.0
720.0	135.0	153.0	8.6	8.3	18.7	18.6	0.0	15000.0	0.0	0.0
760.0	135.0	154.0	8.6	8.3	18.6	18.6	0.0	15000.0	0.0	0.0
800.0	136.0	154.0	8.6	8.3	18.6	18.6	0.0	15000.0	0.0	0.0
840.0	136.0	155.0	8.5	8.3	18.6	18.6	0.0	15000.0	0.0	0.0
880.0	137.0	155.0	8.5	8.2	18.6	18.6	0.0	15000.0	0.0	0.0
920.0	137.0	156.0	8.5	8.2	18.6	18.6	0.0	15000.0	0.0	0.0
960.0	138.0	156.0	8.5	8.2	18.6	18.6	0.0	15000.0	0.0	0.0
1000.0	138.0	157.0	8.5	8.2	18.6	18.6	0.0	15000.0	0.0	0.0

```
VERSN    3  Scenario 38
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  1  9 V   10.0  4.0
MVOPN  3  12 V  10.0  4.0
MVDCT  1  2    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12    0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  10  11   0.0  1000. 75.0
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   10.0  10   10.0  11  10.0  12   10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO     .0072
LFBO  2
LFBT  2
OD    .022
FPOS  2.5 2.5 4.2
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR 1pd17aa.hi
DEVICE 1
WINDOW       0     0  -100  1280  1024   1100
GRAPH   1  120.  300.   0.  600.  920.   10. 5 TIME  METERS
```

```
GRAPH    2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER    0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

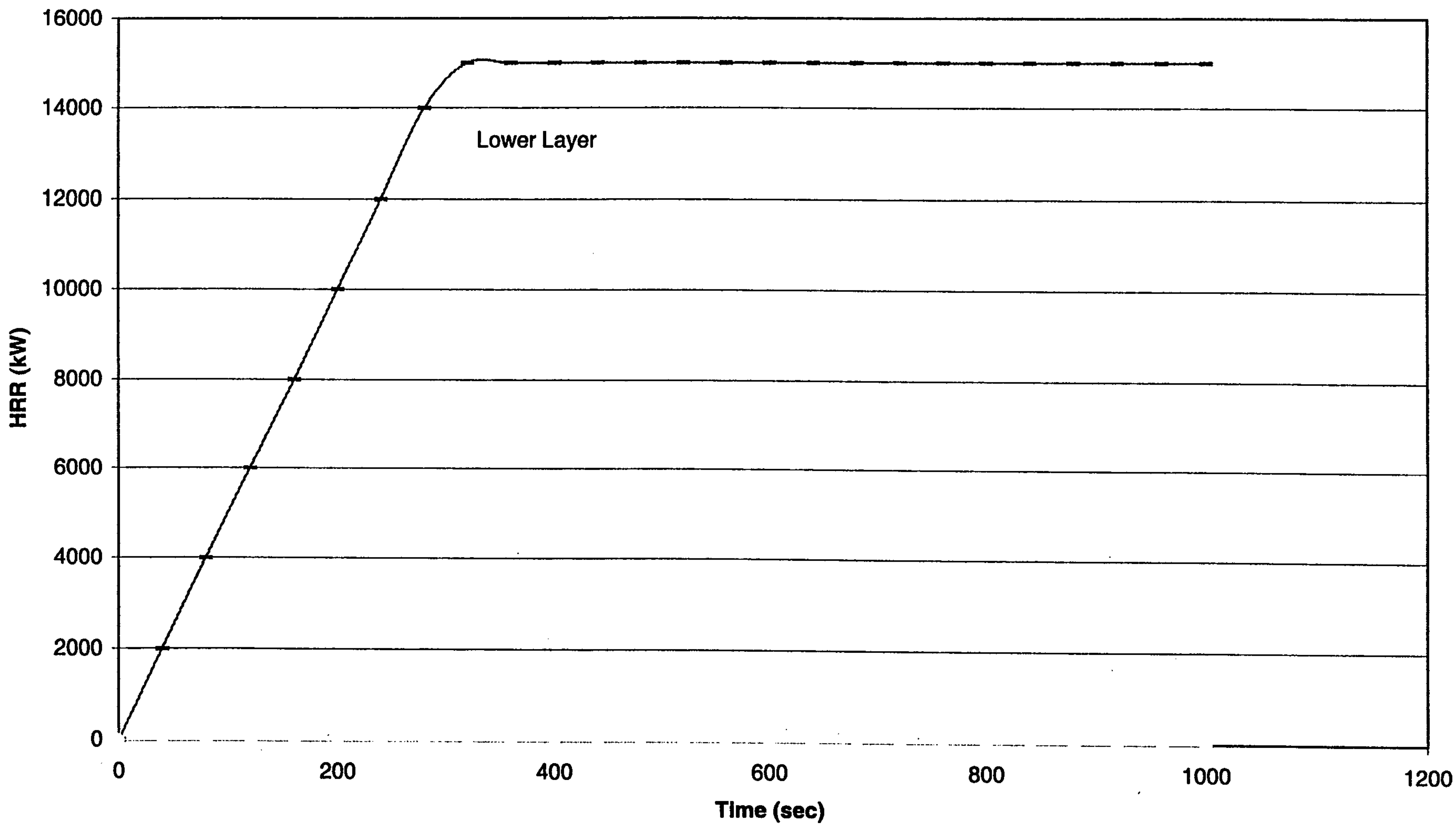
Upper Layer Temperature
UVSA fire
LCAC off, stern gates closed, FS AE mechanical ventilation





Layer Height
UVSA fire
LCAC off, stern gates closed, FS AE mechanical ventilation
Well Deck
UVS/MVS
Layer Height (m)
Time (sec)
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000

HRR, UVSA/MVSA
UVSA fire
LCAC off, stern gates closed, FS AE mechanical ventilation



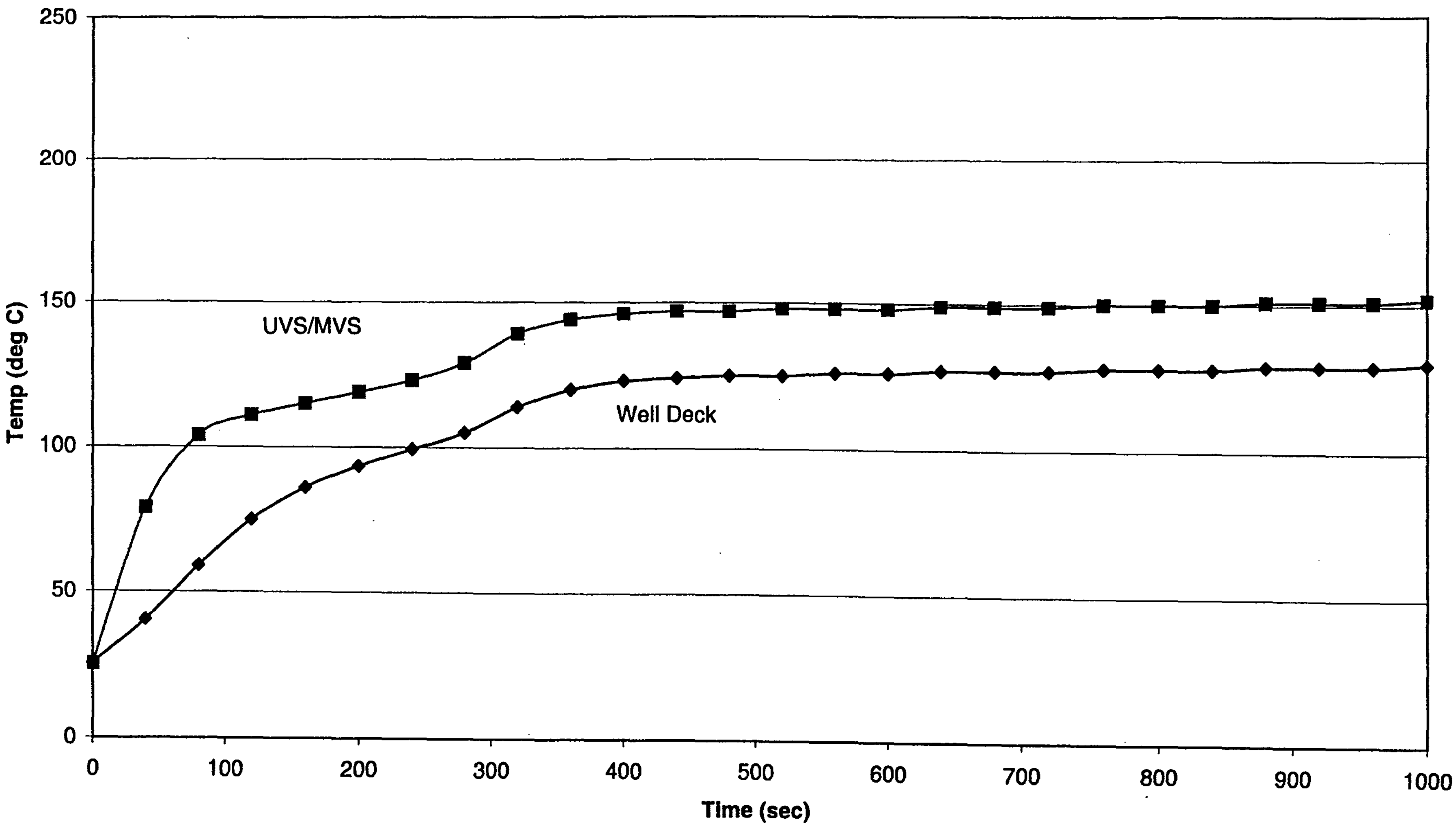
File: lpd17dd.in
TSG: open
BSG: closed
Fire Location: uvsa

LCAC: off
Fans: FS, AE
Opening: 2.8 x 5.0

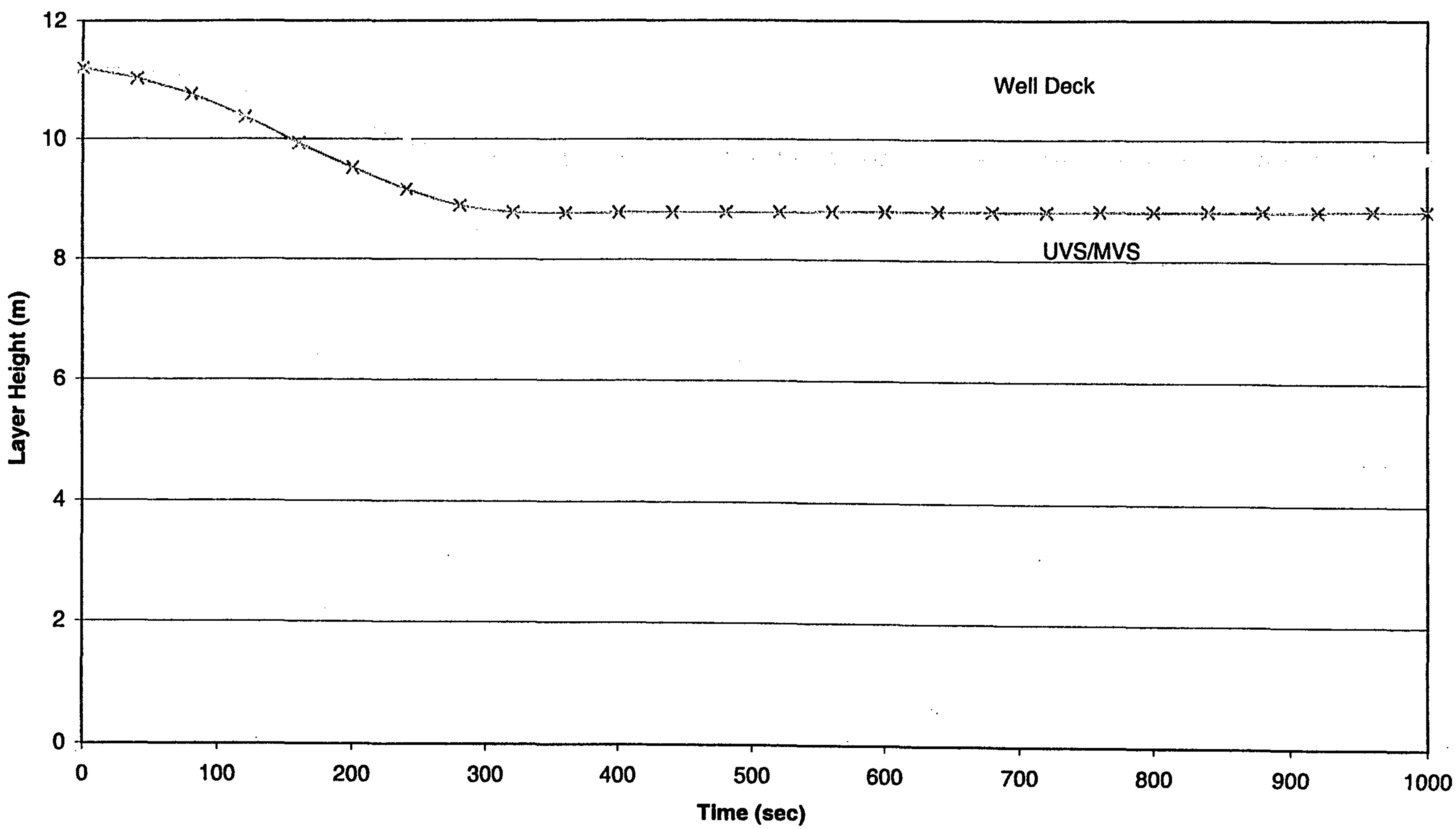
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	40.2	78.7	11.2	11.0	19.9	19.5	0.0	2000.0	0.0	0.0
80.0	59.0	104.0	11.0	10.8	19.4	19.0	0.0	4000.0	0.0	0.0
120.0	74.8	111.0	10.7	10.4	19.1	18.9	0.0	6000.0	0.0	0.0
160.0	86.0	115.0	10.5	9.9	19.1	18.9	0.0	8000.0	0.0	0.0
200.0	93.5	119.0	10.3	9.5	19.1	18.9	0.0	10000.0	0.0	0.0
240.0	99.4	123.0	10.0	9.2	19.1	18.9	0.0	12000.0	0.0	0.0
280.0	105.0	129.0	9.8	8.9	19.1	18.9	0.0	14000.0	0.0	0.0
320.0	114.0	139.0	9.7	8.8	19.0	18.8	0.0	15000.0	0.0	0.0
360.0	120.0	144.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
400.0	123.0	146.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
440.0	124.0	147.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
480.0	125.0	147.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
520.0	125.0	148.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
560.0	126.0	148.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
600.0	126.0	148.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
640.0	127.0	149.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
680.0	127.0	149.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
720.0	127.0	149.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
760.0	128.0	150.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
800.0	128.0	150.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
840.0	128.0	150.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
880.0	129.0	151.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
920.0	129.0	151.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
960.0	129.0	151.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0
1000.0	130.0	152.0	9.7	8.8	18.9	18.7	0.0	15000.0	0.0	0.0

```
VERSN    3  Scenario 39
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8 5.0  0.0
HVENT  1  3  2   18.5 11.0 6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  1  9 V   10.0  4.0
MVOPN  3  12 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  10  11   0.0  1000. 75.0
INELV    1   10.0  2   10.0  3  10.0  4   10.0
INELV    5   6.0  6    6.0  7  6.0  8   6.0
INELV    9   10.0  10   10.0  11  10.0  12   10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 16. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
OD     .022
FPOS  2.5 2.5 4.2
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17dd.hi
DEVICE 1
WINDOW      0     0  -100  1280  1024   1100
```

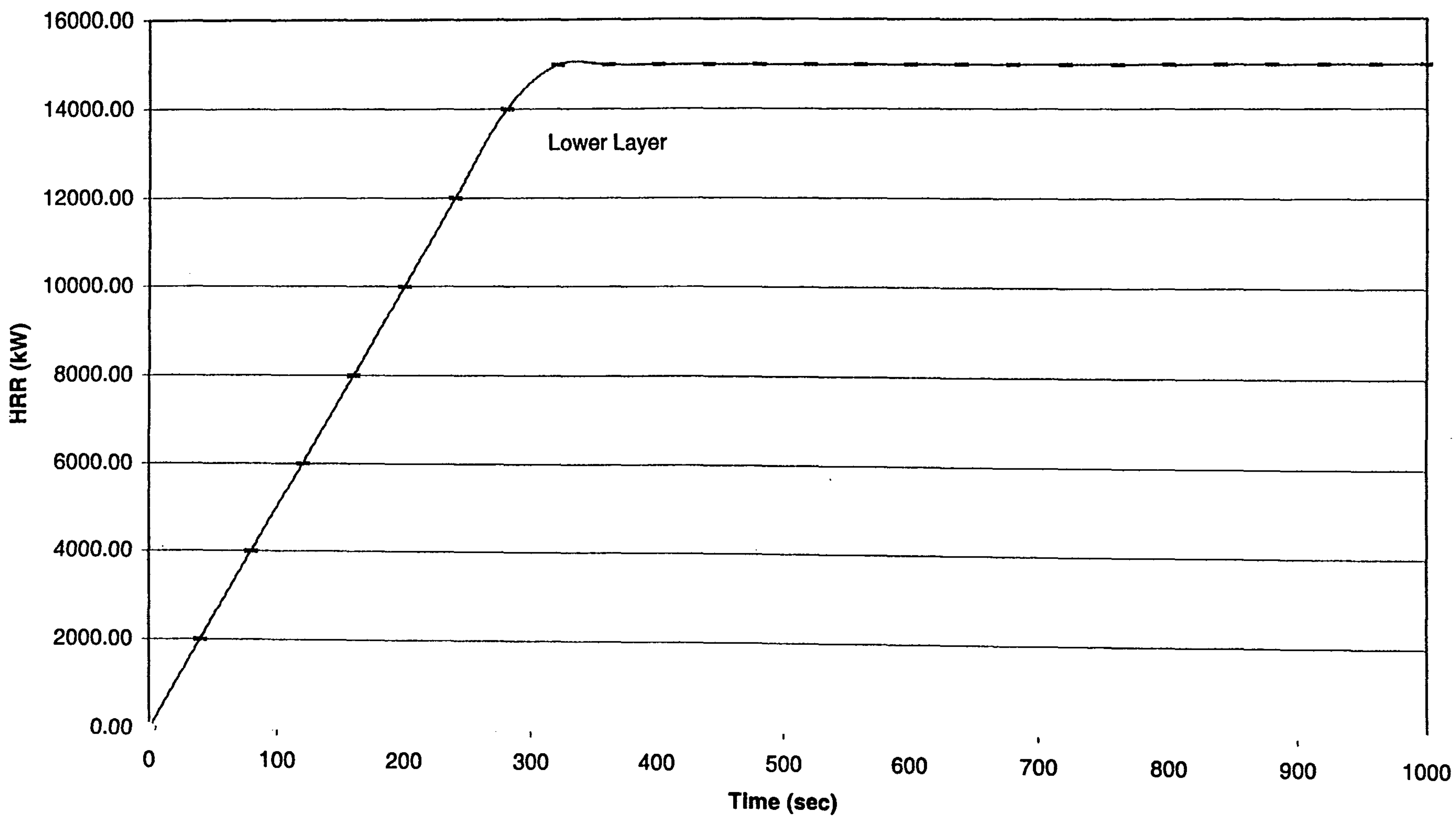
Upper Layer Temperature
UVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open



Layer Height
UVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open



HRR, UVSA/MVSA
UVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open



File: lpd17yy.in
TSG: open
BSG: closed
Fire Location: uvsa

LCAC: supply
Fans: FS,AE
Opening: 2.8 x 5.0

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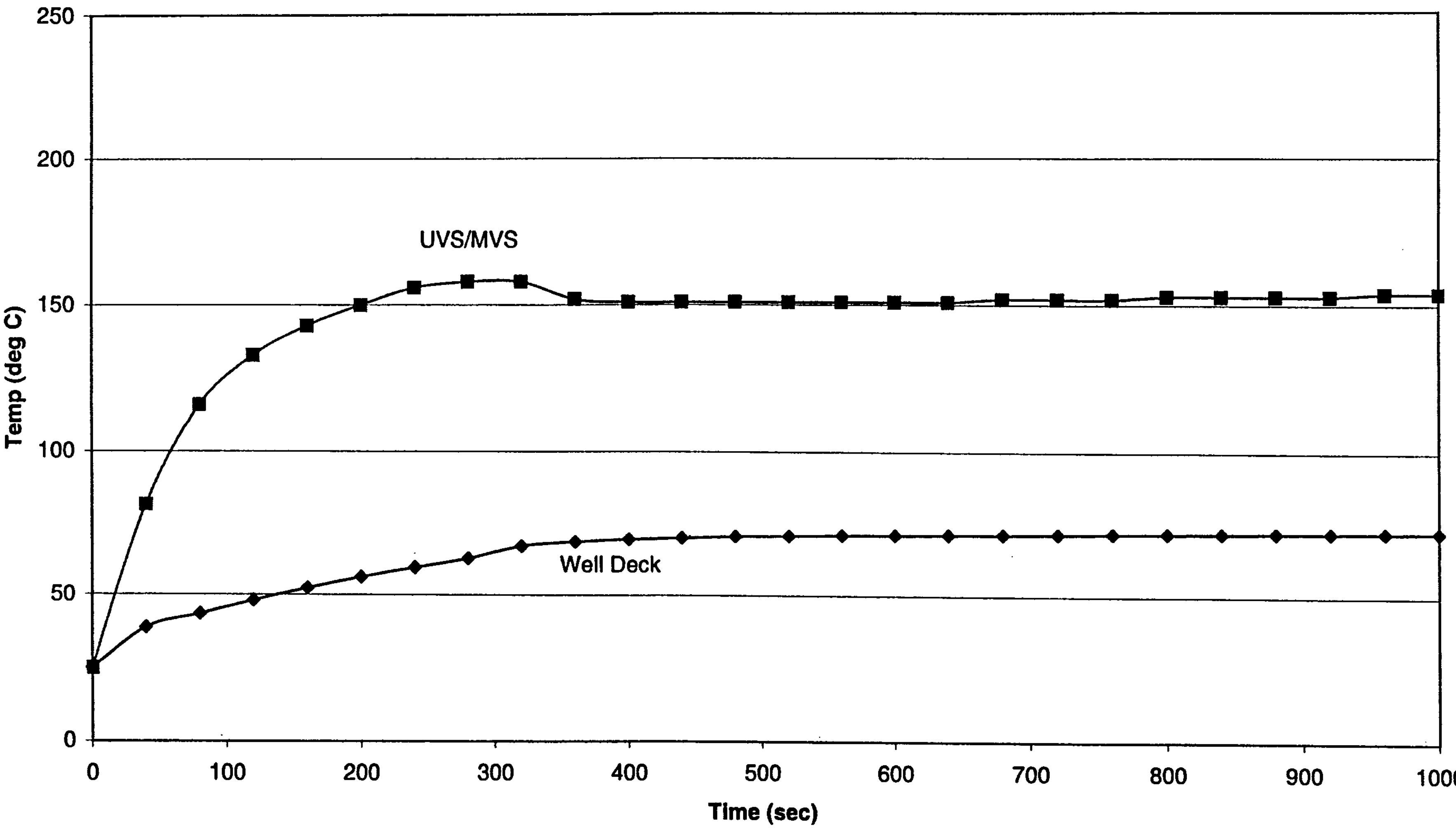
Time (sec)	Upper Layer Temp. (deg C) Comp. 1	Upper Layer Temp. (deg C) Comp. 2	Layer Height (m) Comp. 1	Layer Height (m) Comp. 2	Species % O2 Comp. 1	Species % O2 Comp. 2	Lower Layer HRR (kW) Comp. 1	Lower Layer HRR (kW) Comp. 2	Upper Layer HRR (kW) Comp. 1	Upper Layer HRR (kW) Comp. 2
0.0	25.0	25.0	11.2	11.2	20.6	20.6	0.0	0.0	0.0	0.0
40.0	38.7	81.5	11.1	11.0	20.2	19.8	0.0	2000.0	0.0	0.0
80.0	43.5	116.0	10.6	10.9	20.1	19.4	0.0	3998.0	0.0	0.0
120.0	48.1	133.0	10.2	10.6	20.1	19.3	0.0	5997.0	0.0	0.0
160.0	52.4	143.0	9.9	10.4	20.1	19.2	0.0	7995.0	0.0	0.0
200.0	56.3	150.0	9.6	10.1	20.1	19.1	0.0	9993.0	0.0	0.0
240.0	59.6	156.0	9.3	9.8	20.0	19.0	0.0	11990.0	0.0	0.0
280.0	62.7	158.0	9.1	9.5	19.9	18.8	0.0	13990.0	0.0	0.0
320.0	67.0	158.0	9.0	9.2	19.9	18.7	0.0	14990.0	0.0	0.0
360.0	68.6	152.0	8.8	8.9	19.8	18.7	0.0	14990.0	0.0	0.0
400.0	69.5	151.0	8.7	8.7	19.8	18.7	0.0	14990.0	0.0	0.0
440.0	70.1	151.0	8.6	8.6	19.7	18.7	0.0	15000.0	0.0	0.0
480.0	70.6	151.0	8.5	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
520.0	70.8	151.0	8.5	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
560.0	71.1	151.0	8.4	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
600.0	71.2	151.0	8.4	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
640.0	71.4	151.0	8.4	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
680.0	71.5	152.0	8.3	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
720.0	71.6	152.0	8.3	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
760.0	71.8	152.0	8.3	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
800.0	71.9	153.0	8.3	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
840.0	72.0	153.0	8.3	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
880.0	72.2	153.0	8.3	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
920.0	72.3	153.0	8.3	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
960.0	72.4	154.0	8.3	8.5	19.7	18.7	0.0	15000.0	0.0	0.0
1000.0	72.5	154.0	8.2	8.5	19.7	18.7	0.0	15000.0	0.0	0.0

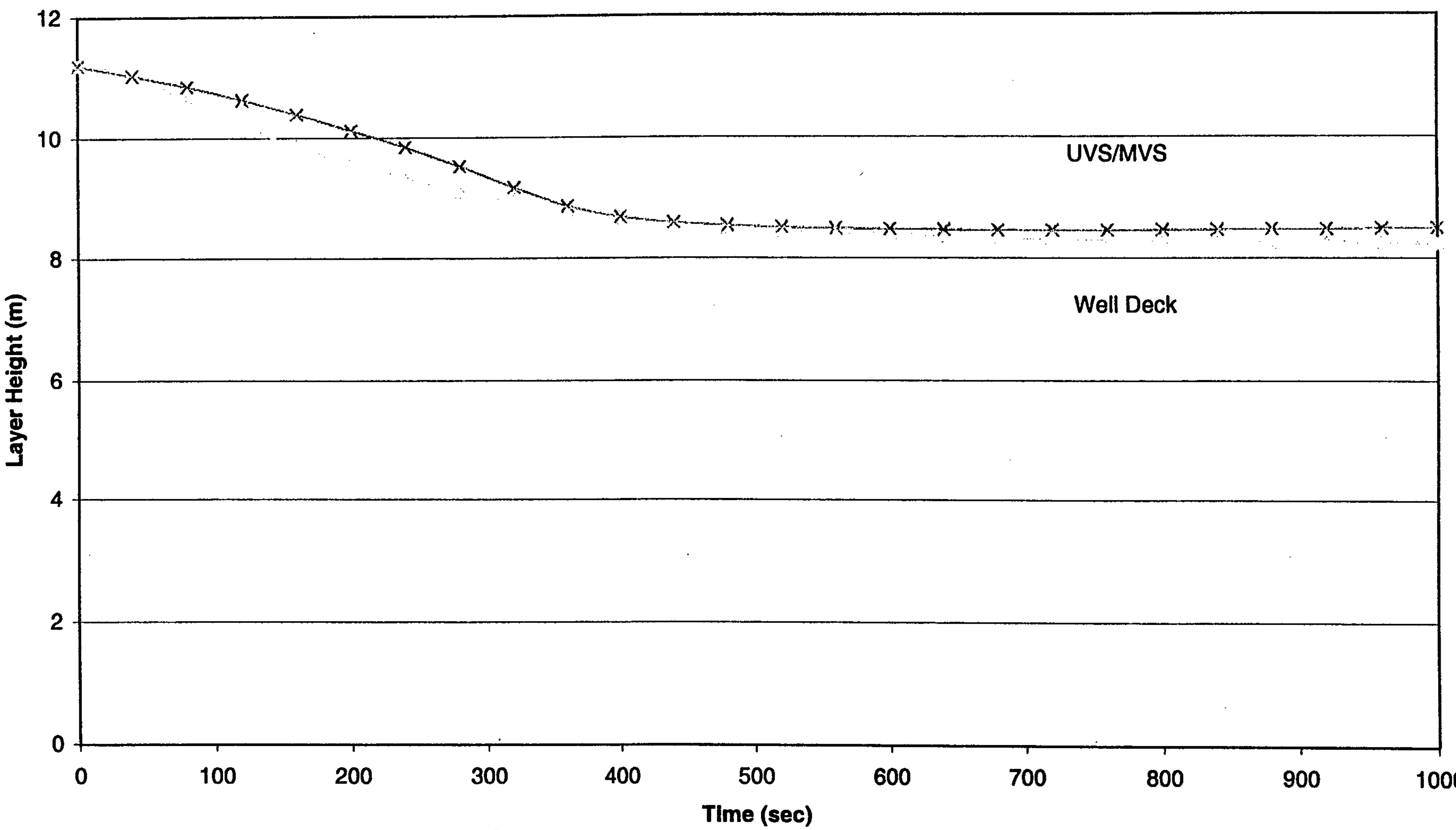
```
VERSN    3  Scenario 40
TIMES 1000  40   40   40    0
TAMB  298. 101300. 0.
EAMB  298. 101300. 0.
HI/F  0.00 3.0
WIDTH  18.5 18.5
DEPTH  57.5 80.0
HEIGH  11.2 8.2
HVENT  1  2  1   18.5 11.2 3.0
HVENT  1  3  1   2.8  5.0  0.0
HVENT  1  3  2   18.5 11.0  6.8
MVOPN  2  1 V   7.0  4.0
MVOPN  3  4 V   7.0  4.0
MVOPN  2  5 V   3.0  4.0
MVOPN  3  8 V   3.0  4.0
MVOPN  2  9 V   9.0  4.0
MVOPN  2  12 V  9.0  4.0
MVOPN  1  13 V  11.2  4.0
MVOPN  3  16 V  11.2  4.0
MVOPN  1  17 V   10.0  4.0
MVOPN  3  20 V  10.0  4.0
MVDCT  1  2   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  3  4   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  5  6   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  7  8   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  9  10   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  11 12   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  13 14   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  15 16   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  17 18   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVDCT  19 20   0.5  5.6  0.002  0.0 5.6 0.0 5.6
MVFAN  3  2   0.0  1000. 42.5
MVFAN  7  6   0.0  1000. 42.5
MVFAN  11 10   0.0  1000. 90
MVFAN  15 14   0.0  1000. 90
MVFAN  18 19   0.0  1000. 75
INELV   1   10.0  2   10.0  3  10.0  4   10.0
INELV   5   6.0  6    6.0  7  6.0  8   6.0
INELV   9   12.0  10   12.0  11  12.0  12   12.0
INELV   13   11.2  14   11.2  15  11.2  16   11.2
INELV   17   10.0   18   10.0  19  10.0   20  10.0
CEILI  STEEL3/8  STEEL3/8
WALLS  STEEL3/8  STEEL3/8
FLOOR  STEEL3/8  STEEL3/8
CHEMI 170. 50. 10. 43000000.  298. 540. 0.336
CO      .0072
LFBO  2
LFBT  2
```

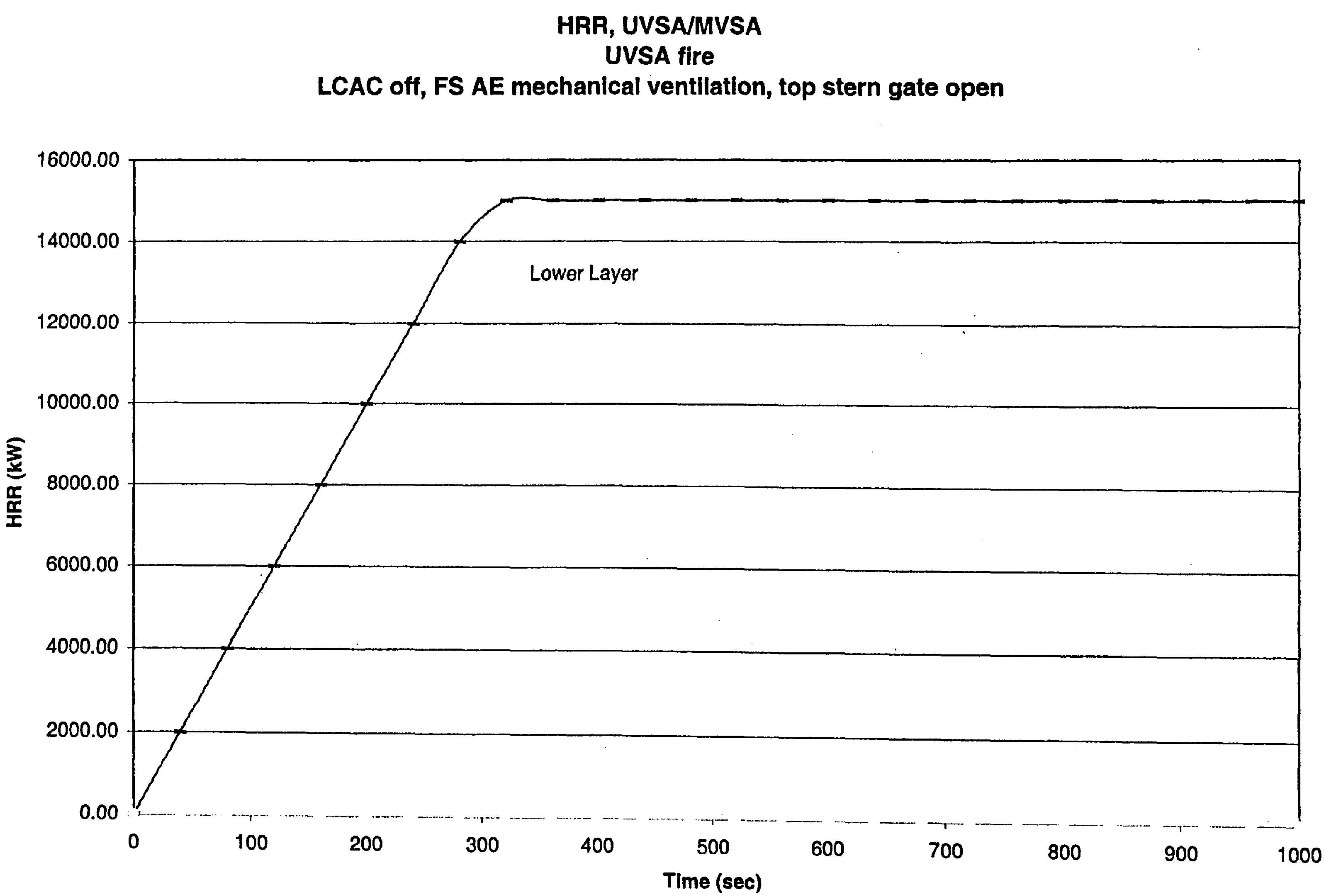
```
OD     .022
FPOS  2.5 2.5 4.2
FTIME 300.0
FHIGH 0. 0.
FAREA 1. 1.
FQDOT 0e3 15000e3  15000e3
CJET OFF
HCR   0.3 0.3
STPMAX  1.00
DUMPR lpd17yy.hi
DEVICE 1
WINDOW        0     0  -100  1280  1024   1100
GRAPH   1  120.  300.    0.  600.  920.   10. 5 TIME  METERS
GRAPH   2  740.  300.    0.  1220. 920.   10. 5 TIME  CELSIUS
INTER   0 0 0 0 1   1 U
TEMPERA 0 0 0 0 2   1 U
TEMPERA 0 0 0 0 2   1 L
TEMPERA 0 0 0 0 2   2 L
```

Upper Layer Temperature
UVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open



Layer Height
UVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open




HRR, UVSA/MVSA
UVSA fire
LCAC off, FS AE mechanical ventilation, top stern gate open
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
HRR (kW)
Lower Layer
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)