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NATREF HF ALKY CLOUD MITIGATION




16 October 2019

HF ALKY CLOUD MITIGATION

SAFETY TOPIC

- Immediate signs and symptoms of exposure to hydrogen fluoride (Centers for Disease Control and Prevention)
- Skin contact:
- Even small splashes of high• concentration hydrogen fluoride products on the skin can be fatal.
- Skin contact with hydrogen fluoride may not cause immediate pain or visible skin damage.

SAFETY TOPIC

- Patients exposed to low concentrations of hydrogen fluoride on the skin do not show effects or experience pain immediately.
- Initially severe pain at the exposure site may be the only symptom for several hours and visible damage may not appear until 12 to 24 hours after the exposure.
- Severe pain can occur even if no burns can be seen.
- Depending on the concentration of the chemical and the length of time of exposure, skin contact with hydrogen fluoride may cause severe pain at the point of contact; a rash; and deep, slow• healing burns.

HF ALKY CLOUD MITIGATION GUIDELINES

A Cloud mitigation system normally contains the following:

1. Water Wall Monitors
2. Spray curtain (via spray nozzles)
3. Aim and shoot monitors
4. Momentum Breaking screens
5. Gas Detection (Atmospheric Monitoring System)
6. Water supply and distribution system
7. Cloud Mitigation Control System (Initiation of in event of incident)

HF ALKY CLOUD MITIGATION

Risk Zones:

- The Cloud Mitigation System is designed to achieve the required water flux at the point of contact with the HF aerosol (480 lpm/m).
- Typical HF cloud dispersion dictates that the most effective mitigation distance from the leak source is 15 m.
- A 15 m risk bubble is plotted surrounding all risk equipment.
- The risk zones give the maximum approach of the water wall to the process equipment.

HF ALKY CLOUD MITIGATION

Water Wall:

- Water wall monitors are placed such that the water wall forms approximately 15 m from the target equipment.
- Momentum breaking screens are installed around equipment to dissipate momentum. This is required around equipment that is too close to the water-wall.
- Where the area is too congested a water curtain is formed with spray nozzles. The Spray nozzles are arranged to mimic the effect of the water wall monitors.

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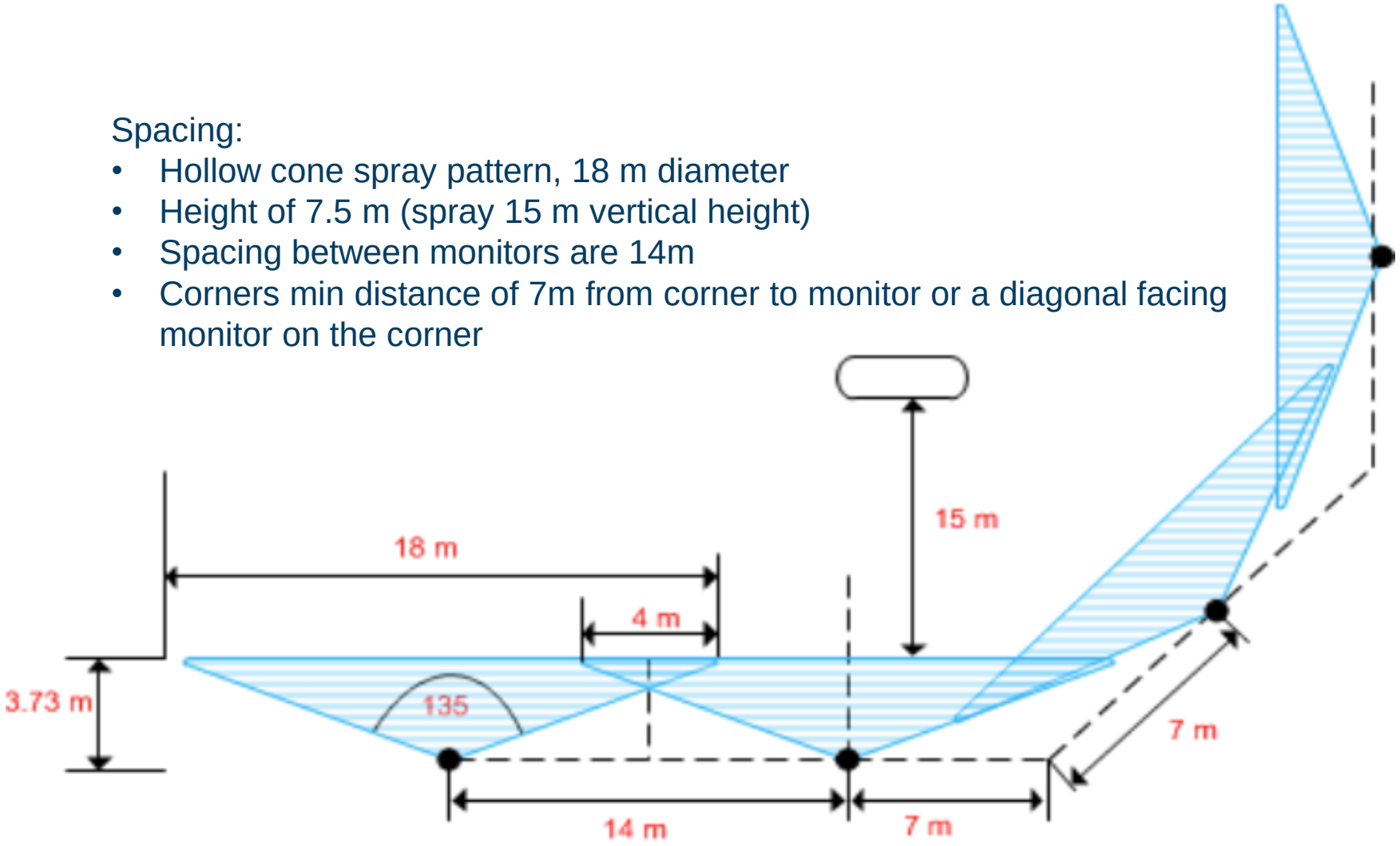
Spacing:

- Hollow cone spray pattern, 18 m diameter
- Height of 7.5 m (spray 15 m vertical height)
- Spacing between monitors are 14m
- Corners min distance of 7m from corner to monitor or a diagonal facing monitor on the corner

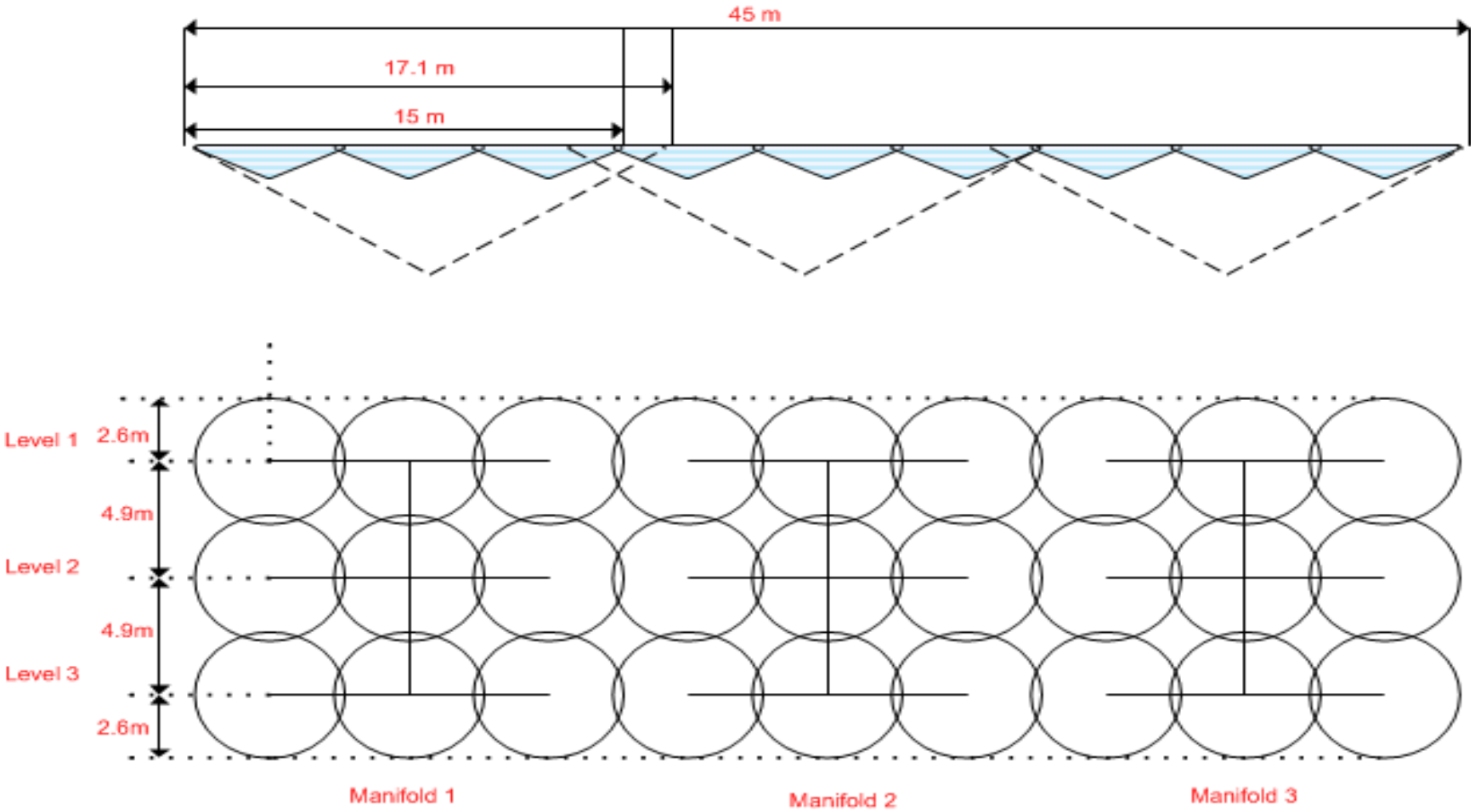


HF ALKY CLOUD MITIGATION

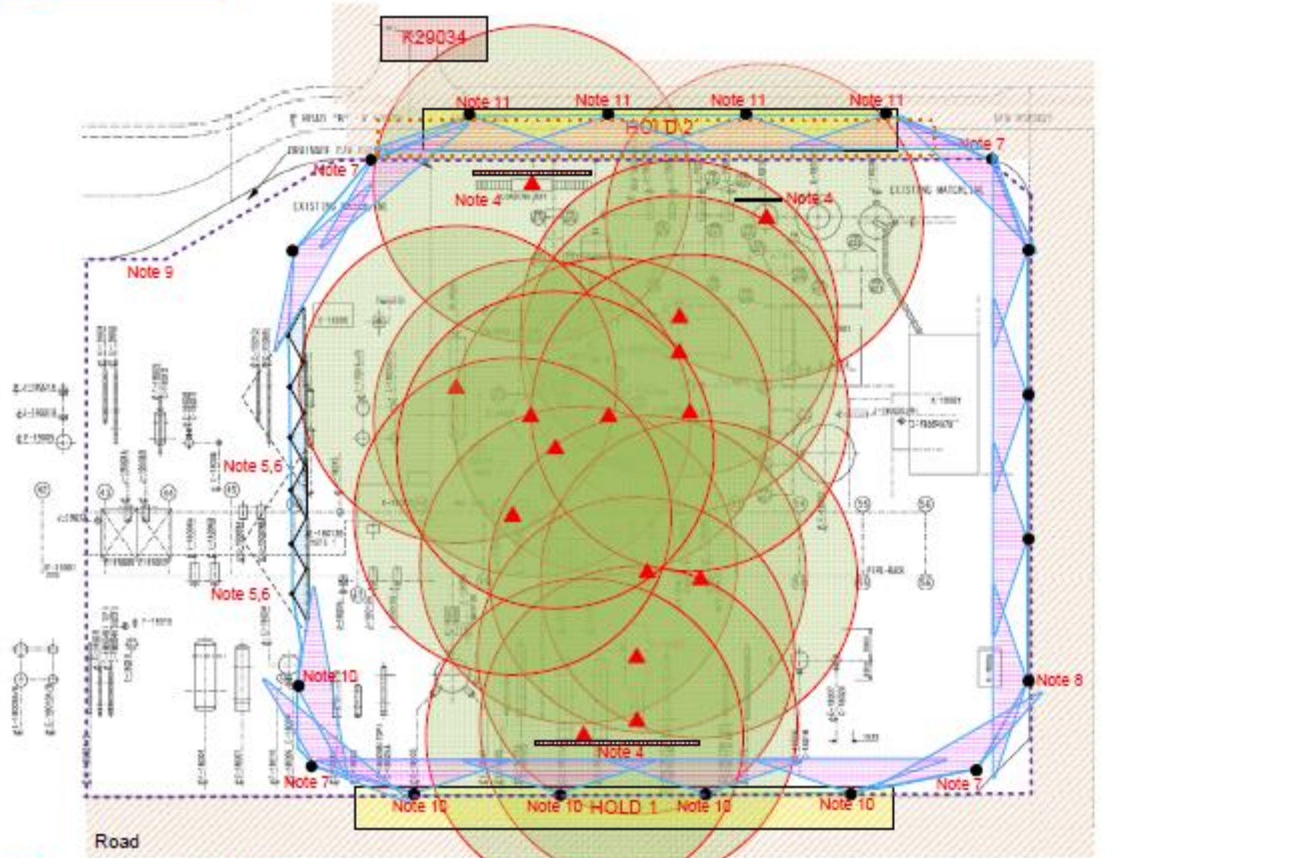
Spray Nozzles:

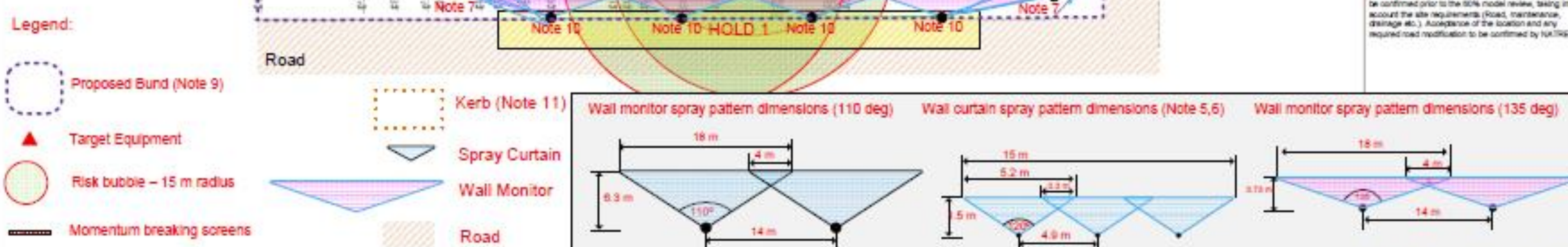
- Spacing
- 120˚ to 170 º hollow cone spray pattern, 18 m diameter (mimic)
- 2 - 3 Manifolds
- 3 Levels
- Height 2.6, 7.5 and 12.5 m (spray 15 m vertical height)

HF ALKY CLOUD MITIGATION



ATTACHMENT 4 - Alternative Layout drawings





NOTES:

1. This drawing is based on an extract from Natref Plot Plan drawing PP18_Rev 18.
2. This drawing is drawn to scale as accurately as possible, but can however not be taken as being 100% accurate. A cadded version of this drawing must be prepared during Detailed Engineering, at which time the geographical layout of the site, as well as other physical barriers must be properly considered.
3. For details on the layout philosophy, refer the project Design Basis, A70S-4010-225-DB-001.
4. The water wall monitors are placed such that the water wall forms approximately 15 m from the target equipment. The deflection shields are installed around equipment to dissipate momentum. This is required around equipment that is too close to the water wall.
5. Where the area is too congested a water curtain is formed with spray nozzles. The spray nozzles are arranged to mimic the effect of the water wall monitors.
6. Along sections where there is limited clearance for the wide cone monitors, a spray nozzle arrangement or solid partition are recommended alternatives. The current design shows the recommended spray nozzle arrangement. This must however be verified during the 60% model review. If spacing limitations do not allow for proper configuration of the spray nozzles, a solid partition must be installed. The spray nozzle detail design must be confirmed by the Vendor.
7. Monitor is placed to spray diagonally inwards and is located just inside the HF Alky Plant boundary. This is an acceptable approach to ensure the continuation of the wall around a sharp corner (R. Cecchetti, 2006).
8. The physical location of the monitor must be verified during the 60% model review. Currently the monitor is located behind the building, but is elevated 7.5 m above ground.
9. Proposed bund design and location by "others". Effluent management & handling currently under review by the "client". Proposed bund can extend (if required) to North Battery limit of Butamer Unit.
10. It is possible to adjust the vertical spray angle (tilt) of the water wall monitors. This will reduce the distance required for a water wall to form. In areas where placement of the monitors are limited due to existing infrastructure such as roads and other equipment, the spray angle will be adjusted.
11. Water Wall monitors proposed to be placed east of the new/existing kerbed section of road R. Road R to be extended on East side of monitors.

HOLDS

HOLDS:

1. Monitors located on the edge of Road C. The exact location to be confirmed prior to the 60% model review, taking into account site requirements (Road, maintenance, drainage etc.). Acceptance of the location and any required road modification to be confirmed by NATREF. If monitor location is not acceptable, an alternative option would then be to install spray nozzles to form a "curtainwall".
2. . The proposal is to extend the existing loading bay Kerb along Road R (as indicated) and for the new Monitors to be located on the edge of this Kerb. It is proposed the existing road is then widened on the East side of the monitors for site traffic. The exact location to be confirmed prior to the 60% model review, taking into account the site requirements (Road, maintenance, drainage etc.). Acceptance of the location and any required road modification to be confirmed by NATREF.

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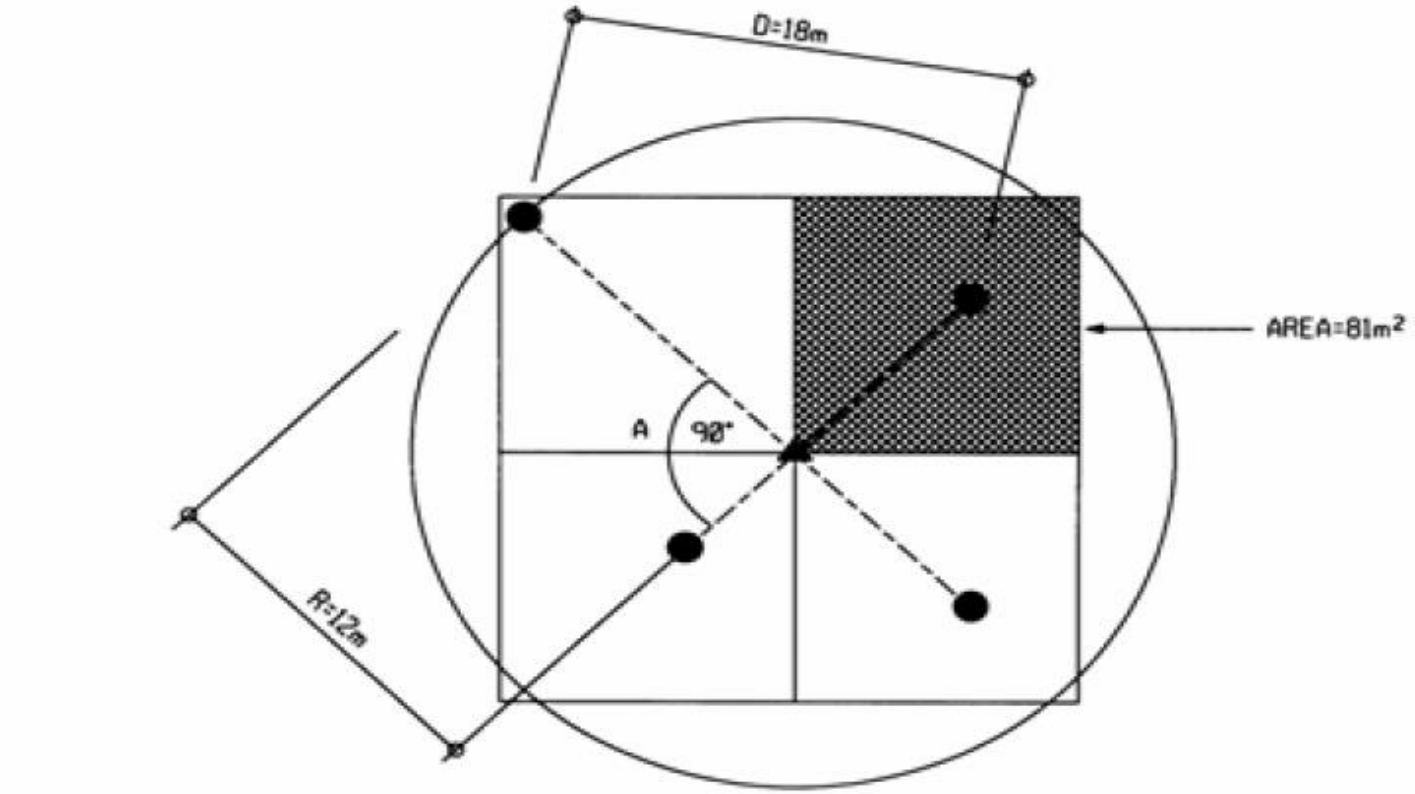
HF Alky Cloud Mitigation Project
Water Wall Drawing
A70S-4010-225-DW-002

HF ALKY CLOUD MITIGATION

Gas Detector Layout:

- PD near HF leak sources
- OP detectors - perimeter detectors.
- PD gas provided for every 81 m2 of floor area coverage per gas detector, and within 12 m of the potential source of release and within 18 m of an adjacent detector, spaced at 90 degrees from each other to cover the four wind directions (As per SP-00-02, Rev 5).
- Existing detectors shown
- Detectors divided into Zones (1-4)

FIGURE 3 – GAS DETECTOR LAYOUT



● GAS DETECTOR

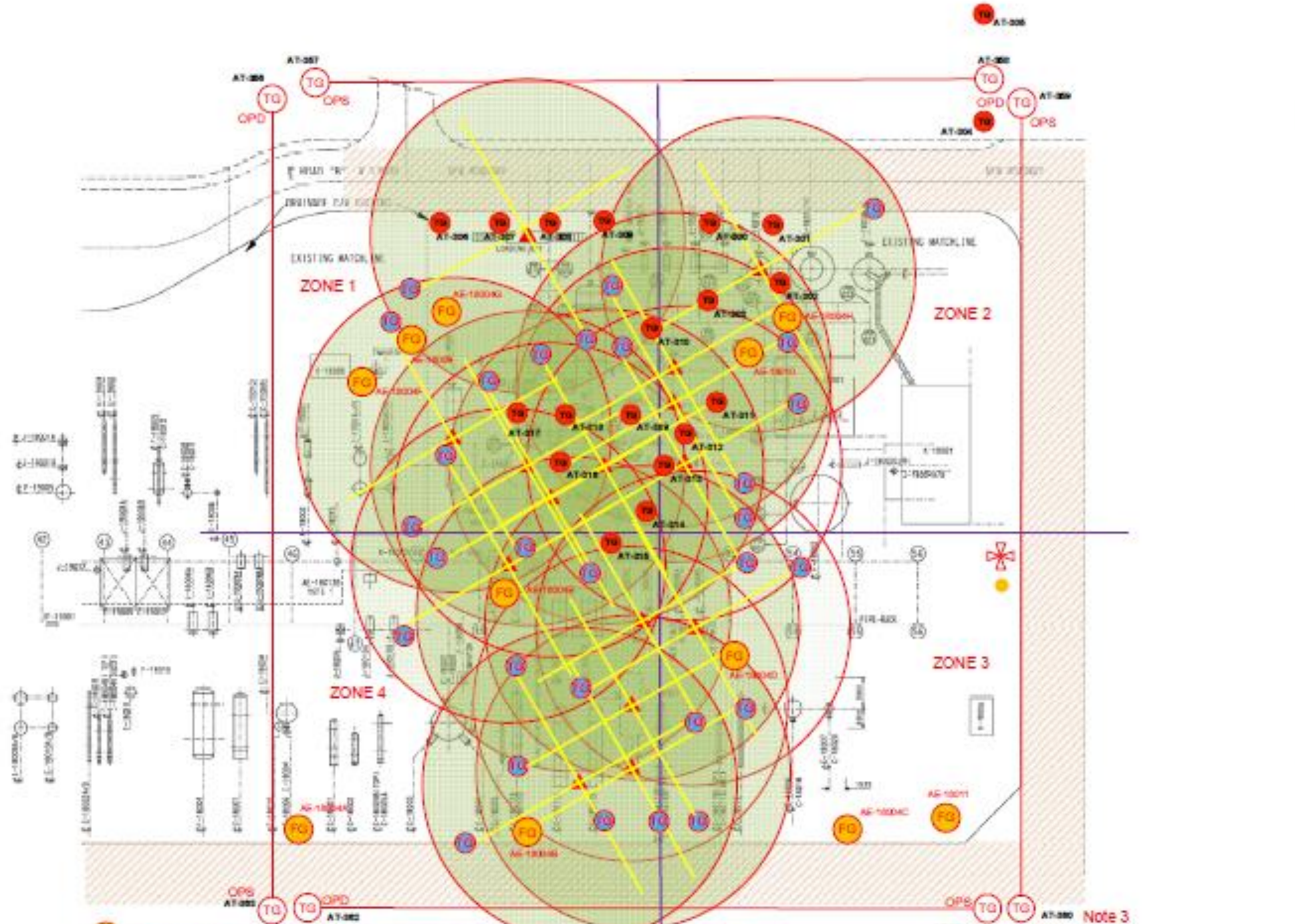
▲ POTENTIAL GAS SOURCE

▩ AREA COVERED BY A GAS DETECTOR SHALL BE 81 SQUARE METER MAXIMUM

A GAS DETECTORS SHALL BE SPACED AT 90 DEGREE ANGLES TO COVER ALL POSSIBLE WIND DIRECTIONS

R DISTANCE BETWEEN GAS DETECTORS AND GAS SOURCE SHALL NOT BE MORE THAN 12 METERS

D DISTANCE BETWEEN GAS DETECTORS SHALL BE MAXIMUM 18 METERS



Legend:

- Target Equipment
- Risk bubble – 15 m radius
- Existing HC detectors (point – electrochemical type) – 11
- Existing HF detectors (point – electrochemical type) – 20 (Note 10, HOLD 1)
- New HF detectors (point – electrochemical type) – 28 (Note 6, 7,10)
- Existing Toxic Gas Detector – 08 (4 pairs) (Note 10, HOLD 1) Open path source – Open path detection (OPS, OPD)
- Shows 12 m distance from point source in four wind directions (Note 4)
- Siren – 01 (Note 9)
- Strobe – Toxic Gas (Amber) – 01 (Note 8)
- Road

Scale: 6 m

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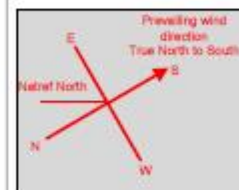
3. Point detectors are provided near high potential HF leak sources and open path detectors serves as perimeter detectors.
4. Point type gas detectors shall be provided for every 81 m2 of floor area coverage per gas detector, and within 12 m of the potential source of release and within 18 m of an adjacent detector, spaced at 90 degrees from each other to cover the four wind directions (As per SP-00-02, Rev 5).
5. ~~[illegible]~~
6. Point detectors to be placed between 0.5 and 0.75 m from grade to ensure detection of gas cloud that is heavier than air.
7. ~~[illegible]~~
8. Strobe light around the unit to annunciate confirmed emergency.
9. A single alarm high will automatically sound a specific toxic release alarm in the Alkylation unit.
10. Number and location of existing detectors to be confirmed by client. Client to advise if existing detectors requires replacement.



HOLDS:

1. As built drawing of existing Gas Detectors and Open path detectors to be provided by NATREF

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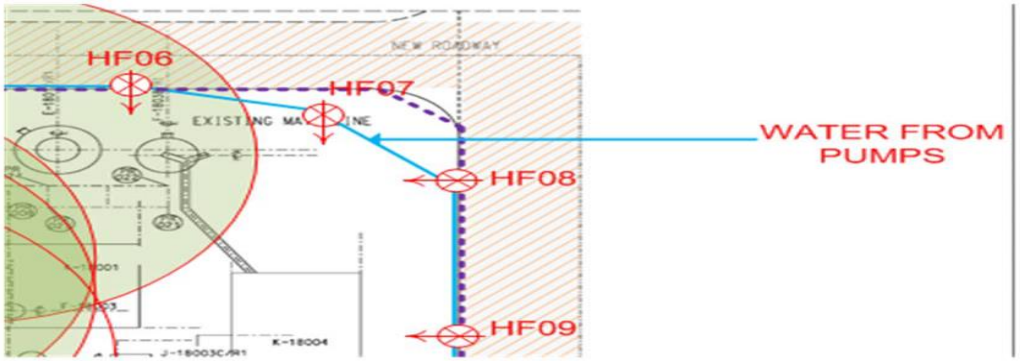
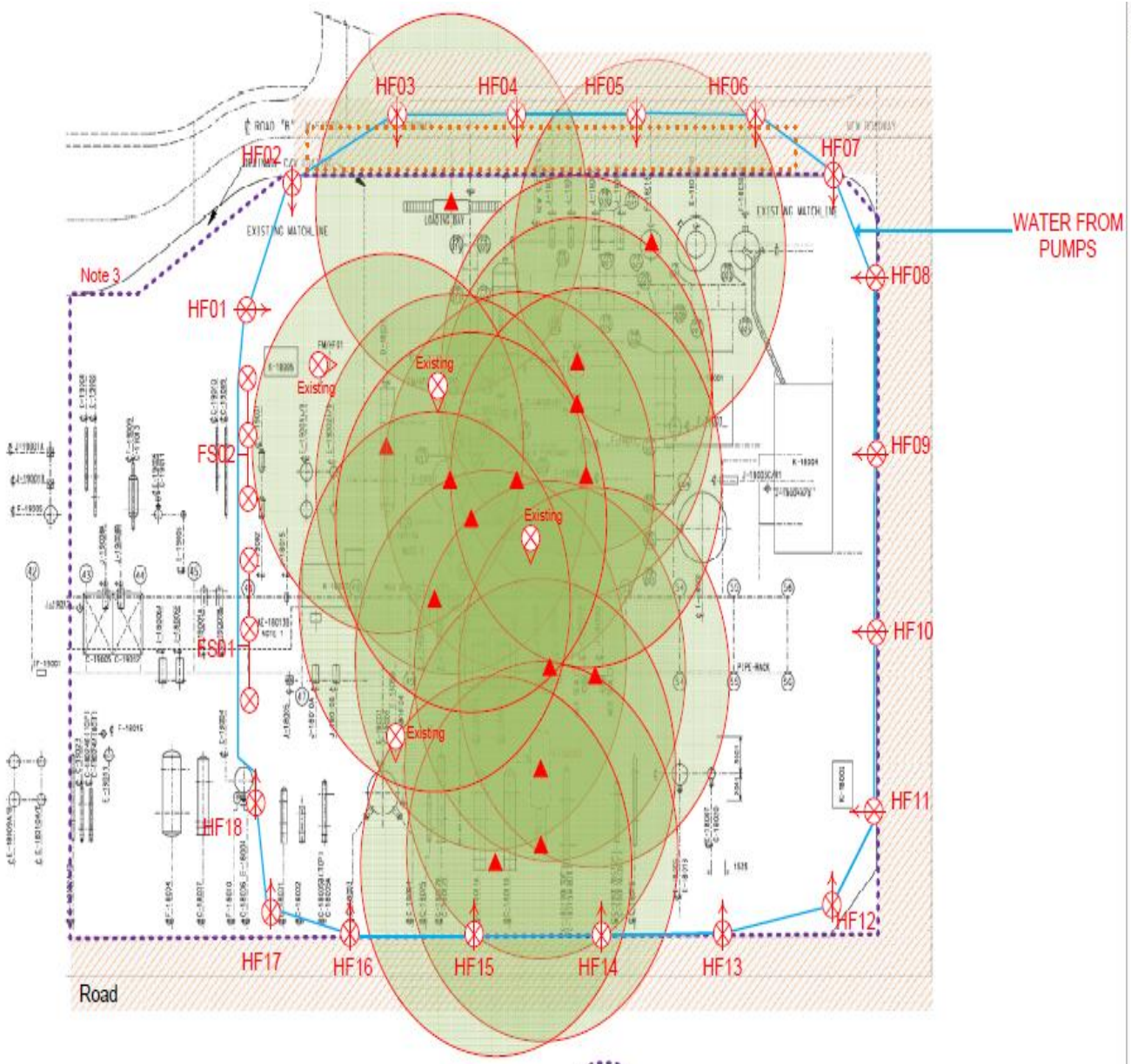
HF Alky Cloud Mitigation Project
Gas Detection Layout Drawing
A70S-4010-225-DW-003

HF ALKY CLOUD MITIGATION

Water Distribution Network:

- Shows proposed layout of water distribution system.
- Bund - max of 6 m from the base of the new monitors.
- Limit the water build-up to a maximum of 100 mm.





3. Proposed bund design and location by "others". Effluent management & handling currently under review by the "client".

HF ALKY CLOUD MITIGATION

HF ALKY CLOUD MITIGATION

High Volume Hydrant 150mm

Natref Mitigation

- The refinery has a written emergency response and control plan for the HF alkylation unit.

  The emergency response and control plan includes at least the following :

  - Evaluation of the consequences of a potential HF release in addition to an LPG release.
  - The need for and location of emergency medical treatment for HF exposure, including the location of clinics and hospitals that are familiar with HF burn care.
  - A system for communicating internally within the refinery and externally to the surrounding community on a response appropriate to the situation; for example, evacuation or shelter-in-place.
  - The frequency and methodology of testing of all communication systems is to be included.
  - The scope and frequency of emergency response drills for LPG and HF releases.
  - The need for or access to off-site emergency response equipment and emergency response personnel trained in handling HF and personal protective equipment suitable for HF exposure.
  - The potential for HF contamination in runoff water.
  - The mechanism for assessing the condition of and decontaminating equipment, soil, buildings and standing water inside and outside the alkylation unit after an HF release is over.

Natref Mitigation

- The refinery has written procedures for initiating an emergency response at the Alkylation unit.
- Notification, interfaces and expected response of external emergency services, including, but not limited to, police, fire, mutual aid, hospitals and local emergency management agencies (LEPCs).
- A process hazards analysis was conducted on the HF alkylation unit.
- The refinery emergency action plan includes at least two scenarios related to the HFA. One dealing with HF leaks, the other one dealing with GPL leaks.

Natref Mitigation

- Emergency response team criteria shall define minimum shift staffing levels
- Emergency response training specific to HF include the physical and health hazards associated with HF, types, use, and limitations of HF unit PPE, medical response, decontamination, and heat stress.“
- "The wearing of Type C suit is mandatory whenever exposure to HF is possible. This includes the first opening of lines and equipment during turnarounds. “
- HF personal PPE is stored in the HFA change room in two clearly demarcated zones. One is dedicated to contaminated PPE, the other one is for cleaned & new PPE. Each zone has its own access.
- "The alkylation unit is audited at least every 4 years (full multidisciplinary, multi day, field audit, called ‘HFA AUDIT’).
- An interim audit dedicated to the control of the progress of the action points (desktop, one day exercise, called ‘RALK’).
- All audit findings are prioritized and are tracked and stewarded to resolution by the refinery owner/operator.

Hydrofluoric Acid Safety

Personal Protective Equipment (PPE)

Natref Mitigation

- Written procedures for HF sampling are in place
- Appropriate training is provided for all operating and laboratory personnel who may collect or handle samples that contain or may contain HF.
- "HF sampling connections are either located at grade level or on an unobstructed structure that permits easy egress for persons taking samples"
- A safety shower is located in close proximity to the HF sampling station
- "The HF acid sampling systems for streams that contain HF is designed to minimize exposure of personnel to HF (closed loop system – fitted with remote operated isolation valves)“
- "HF sample connections have two block valves per connection. When the connection is not in use, both valves are closed and the open end of the sample connection is sealed or plugged.

Natref Mitigation

- "The use of level gauge glass is banned in HF service. All remaining level glass remaining temporary in service must be equipped with ball check valves and protective Kel-F inner sheet.
- "Training is provided for all personnel who enter or work in the HF alkylation unit, or who are designated to respond to emergencies in the unit, on the use of applicable personal protective equipment and clothing. “
- Written procedures are established to remove, neutralize, and clean clothing, and to prevent contamination of HF-free areas.
- "Easily identifiable safety showers and eyewash stations are provided in the HF alkylation unit and other areas of the refinery where HF may be present.
- "The HF unit limits are clearly demarcated by a chain. Crossing the chain is strictly forbidden for both personnel and material. Both must enter or leave the unit through clearly defined access points. "
- "Suitably equipped first-aid kits are readily available in the HF alkylation unit and other areas of the refinery where HF may be present or where HF exposure treatment may be given."

Natref Mitigation

"The HF alkylation unit shall have the following mitigation system capabilities :

- Continuous HF release detection.
- Remotely activated and remotely-controlled water mitigation.
- Event duration management systems that ensure a release event is managed to the user-defined.
- Evaluation criteria.

- "The HF detection systems consist of HF sensors of sufficient number to provide coverage to areas of the unit that contain HF, a perimeter laser barrier , closed-circuit television for remote surveillance of the unit, and HF detecting paint."
- The water mitigation system is specifically designed for HF mitigation.
- "On top of the manual activation option, the mitigation systems shall be automated and triggered by both the local detectors and the laser barriers (voting system)."