केस स्टडी/ CASE STUDY

OISD/CS/2026-27/MOLPG/13 **Date: 30.09.2026**

INTRODUCTION

Title: Flash flooding at LPG Bottling Plant.
Location: LPG Bottling Plant.
Result/ Outcome: Cylinders stacked on ground washed away by the flood waters.

BRIEF OF INCIDENT

Due to continuous heavy rainfall, flash flooding occurred at the LPG Bottling Plant on 08.07.2026 at around 1330 hrs, resulting in approximately 4120 empty LPG cylinders stacked on the ground near the DPT Shed being washed away.

A natural Nullah, carrying runoff from nearby hills, villages and the catchment area, passes through the plant. A continuous rise in Nullah water level was observed, and the inlet/outlet sluice gates were operated to facilitate water flow. At around 1315 hrs, the Plant Manager observed a sudden rise in water level, alerted personnel, suspended operations and directed everyone to move to higher ground.

Floodwater began receding by 1415 hrs and substantially drained by 1445 hrs. Search operations resulted in the recovery of 1,259 LPG cylinders.

The flood damaged the canal embankment, boundary-wall foundation and sluice-gate mesh. No major process equipment was damaged; however, the ETP and cylinder-transfer-conveyor motors near the DPT Shed were submerged due to their lower elevation.

OBSERVATIONS/ SHORTCOMINGS

1. The flash flood caused the following civil infrastructure damage:
   - Approximately 75 m of canal embankment was washed away.
   - Soil beneath the boundary-wall tie beam near the Nullah was eroded over approximately 25 m.
   - The fixed sluice-gate mesh/grill was washed away.
2. The Nullah width varies from 8.145 m to 15.987 m, creating hydraulic constrictions and expansions. Narrow sections increase flow velocity, hydraulic forces, scouring and erosion, while constrictions may cause backwater effects and overtopping. Sudden width changes create turbulence and eddies, potentially affecting the stability of the Nullah, embankments and adjacent structures.
3. No flood-warning system integrated with the emergency response system is available for timely evacuation and response.
4. Existing CCTV and illumination are inadequate for continuous monitoring during adverse weather and flood emergencies.
5. No documented Monsoon Preparedness SOP is available for pre-monsoon inspection of drainage, sluice gates, embankments, structures, emergency equipment and communication systems.
6. Existing QRA, HAZOP, HIRA and ERDMP do not address natural hazards, including flash flooding, catchment runoff and hydrological risks associated with the Nullah.
7. Fixed sluice-gate mesh/grills are susceptible to blockage by debris and vegetation, reducing the effective flow area and restricting floodwater flow, thereby increasing upstream water levels.

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REASON OF FAILURE/ ROOT CAUSE:

1. Deluge over the upstream catchment, causing a sudden surge of runoff and flash flooding through the Nullah.
2. Inadequate hydraulic capacity of the Nullah, due to abrupt width variations, resulting in flow constrictions, high velocity, turbulence, backwater effects, erosion and overtopping.
3. Blockage of sluice-gate mesh/grills by debris and vegetation, reducing the effective flow area, restricting floodwater flow and contributing to erosion and floodwater ingress.
4. Storage of empty LPG cylinders at a lower elevation near the Nullah, making them susceptible to buoyancy and displacement by rising floodwater.

RECOMMENDATIONS:

1. Conduct a comprehensive Hydrological, Hydraulic and Flood Risk Assessment covering the upstream catchment, rainfall, watershed, drainage pattern and historical flood data, and implement suitable mitigation measures.
2. Conduct a detailed engineering assessment of the Nullah, inlet/outlet sluice gates and drainage system for hydraulic capacity, structural integrity and performance, and upgrade/reconstruct wherever required.
3. For new LPG plants/installations, conduct hydrological, topographical and flood-risk assessments during site selection, including highest flood levels, groundwater table, natural streams and canals, in accordance with OISD-STD-118.
4. Incorporate extreme rainfall, flash floods, catchment runoff, hills, Nullahs, upstream dams and other natural hazards into QRA, HAZOP, ERDMP and other risk assessments.
5. Conduct a third-party structural stability assessment of the boundary wall, canal embankments, retaining walls and other affected civil structures.
6. Avoid ground-level LPG cylinder storage; store de-gassed/unpurged cylinders on elevated platforms away from Nullahs and flood-prone areas to prevent them from being washed away.
7. Provide CCTV surveillance with adequate illumination, recording and real-time monitoring covering the Nullah, sluice gates, flood-prone areas and cylinder storage locations.
8. Explore an automated water-level monitoring and sluice-gate operating system with sensors, remote monitoring, automatic operation, manual override and alarms at predefined levels.
9. Install a multi-stage audio-visual flood-warning system with graded alarms linked to the plant emergency response system for timely evacuation, equipment shutdown and flood response.
10. Establish coordination with DDMA, Irrigation Department, IMD, local administration and other agencies for advance weather forecasts, flood alerts and upstream water-release information.
11. Conduct periodic flood-preparedness training, competency development and mock exercises for officers, employees, contract personnel and security staff. Integrate water-level monitoring with SMS/WhatsApp/email alerts for key plant officials and emergency response teams.
12. Conduct an Off-site Emergency Mock Drill at least annually in coordination with relevant authorities and mutual-aid agencies, with lessons learnt incorporated into corrective actions.
13. Develop a detailed Monsoon Preparedness SOP and Checklist covering drainage, Nullah, channels, culverts, sluice gates, embankments, retaining walls, emergency equipment, pumps and communication systems.

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