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NEWSLETTER

OIL & GAS DEVELOPMENT COMPANY LIMITED

JANUARY - MARCH 2022

Tête-à-tête with Managing Director



On 31.03.2022 and 01.04 2022, honorable Managing Director along with CFO, ED (P&P) and GM Production visited Nashpa and Dakhni Oil & Gas Fields. HSE orientation was delivered in the Conference Hall of CCR (Nashpa) and Conference Room (Dakhni). During HSE induction and meeting, following informative Q&A session took place:

MD: HSE Orientation must be conducted before

entering plant area & now we have reached the plant area which is hazardous, why Safety Induction being conducted here?

HSEQ Rep.: A new conference hall dedicated for HSE matters is being constructed which is almost 90% complete and soon orientation will be carried out there i.e. before the plant's entrance area.

MD: How many area classification zones are

there?

HSEQ Rep.: There are three type of zones i.e. 0, 1 & 2. Our plant site area is in zone 1 & LPG filling gantry in Zone 0.

MD: I see siren codes in the presentation/ slides pertaining to fire emergency, toxic gas release & hydrocarbon vapor / fumes release; but is there any toxic gas like H₂S present in Nashpa?

HSEQ Rep.: No Sir.



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MD: Then this specific information from the slide needs to be removed to avoid confusion.

MD: Why do HSE Leading and Lagging Indicators seem quite low especially the Near Misses and First Aid cases?

HSEQ Rep.: Yes Sir that's true; but we keep on imparting HSE trainings, conducting HSE audits and through HSE rewards & recognition process that reporting of factual data is an obligation on all personnel.

MD: Are mock emergency drills carried out?

HSEQ Rep.: Yes Sir, an annual Emergency Drill Planner is developed and according to this plan, scenario based mock up drills are conducted.

MD: When did the last time the drill conducted?

HSEQ Rep.: In February 2022 (Further discussion made on the drill on the scenario "BLEVE" that was carried out last year in the field in coordination with EMT Head Office.)

MD: What is your site's Emergency Response Plan?

HSEQ Rep.: There exist Field's ERP where duties are assigned to different teams and Sectional ICs. LMT Roster is also updated on fortnightly basis and shared with Head Office.

MD: How could I find out sitting in Conference hall that what level of emergency has occurred?

HSEQ Rep.: Emergency is declared through siren, lights and public address system either for gathering at Muster Points or evacuating through the Emergency Exit Gates. Emergency level / severity cannot be determined instantaneously at that time; only nature of emergency is declared i.e. fire / explosion, toxic gas release or hydrocarbons leakages / oil spillage. Chairman LMT decides to activate LMT, engage Emergency Teams and inform Chairman EMT at Head Office to share incident details. Chairman EMT declares the actual level / severity.

MD: You may try looking into revising siren codes / schemes and emergency levels / severity as per latest standards, guidelines or best

industrial practices by visiting other oil and gas E&P companies and leaning from their experiences to bring further improvement.

MD: How impact of H2S dispersion is proactively monitored on the nearby communities?

HSEQ Rep.: By Ambient Air Quality Monitoring.

MD: There should be a real-time monitoring system for H2S detection/ dispersion at all four sides / boundary walls of the plant so that local community be timely informed in case of H2S emergency.

MD: How do you check Fire Pumps?

HSEQ Rep.: We have Safety Monitoring Plans for monitoring reliability of active & passive emergency systems and Checklists for fire network including pump are followed.

MD: Get more pertinent guidance from NFPA 25 by which fire pumps must be tested on both monthly and annual basis to ensure that they will perform as designed.

MD: Being ISO 45001 certified site, how do you carry out occupational health assessment?

HSEQ Rep.: It is done as per Occupational Health Assessment Plan by Medical Section. Trade tests of workers who are exposed to hazards, drivers, security personnel and food handlers are carried out on priority.

MD: Do you have any checks for crude oil bowzers?

HSEQ Rep.: There exists a detailed Checklist having 64 checks including Security, Logistics, HSEQ and Contractor.

MD: How many Firemen in HSEQ Section and how they are managed?

HSEQ Rep.: 26; but at a time only 13 are present (13 remain on days off). In each shift, there are only 04 crew members including Head Fireman, Fireman & Helper.

(One Fireman is assigned to check the crude oil & LPG vehicles & two are assigned in case of any hot job & fourth maintains fire gadgets.)



MD Planting a Sapling at Dakhni Oil & Gas Processing Plant, District Attock.

MD: What is the role of Firemen during hot job?

HSEQ Rep.: He performs gas testing, clears the area, provide canopy and operate fire extinguisher in case of fire.

MD: It is the duty of permit issuer / receiver, area operator and job performers to detect gas, clear area & operate fire extinguisher just in case. HSEQ team's fundamental role is to train and audit the line management.

MD: Have you conducted any trainings on firefighting?

HSEQ Rep.: Yes Sir; both through internal facilitators at Field Level and also from the 3rd parties like Rescue 1122.

MD: How revisions in the Procedures are communicated and cascaded down the line?

HSEQ Rep.: HSEQ Department timely conveys us the changes approved by MD and also OGTL arranges trainings accordingly. Subsequently, HSE Field Development Facilitators of respective Clusters conduct similar sessions to expedite the learning process in the shortest possible time.

MD: Do you perform TNA?

HSEQ Rep.: Yes Sir; TNA is conducted before chalking out Annual InHouse Training Calendar. However technical domain doesn't.

MD: Safety is everybody's responsibility; all Sections have dual responsibility i.e. toward operation / maintenance and HSEQ in tandem.

Lastly, MD appreciated combined efforts towards HSE implementation; however anticipated improvement opportunities to be availed. He was of the view that field level HSE procedures / protocols need a review in coordination with location InCharges and all the people at field needs proper understanding of the same.



Major Gas Processing Plants Celebrated HSE Awareness Events



To bring out positive change and culture, HSE Awareness Events have been organized in various production fields since 2009; however these events couldn't be organized in recent past due to COVID-19 pandemic. To further promote & campaign for the best HSE practices, the opportunity again being availed in this spring season (February–March), HSE Awareness Event FY2022 celebrated at ISO45001 & ISO14001 certified-and-compliant-fields (KPD-TAY, Dakhni, Nashpa, Chanda-Mela, Sinjhora, Bobi, Qadirpur, Uch, Rajian). Due to pandemic, security & other concerns, instead of making HSE Awareness Event an outsized ceremonial event drawing media-hype, the event were confined to 01 to 02 half-half days sessions and limited (relevant) personnel pulled together to achieve the core objective (e.g. aim was to accommodate the presence of maximum 100 participants) and the Events kept simple to curtail the cost to minimum. There are several goals usually focused in these

events for example a) increase awareness of the high hazard / risk rated areas, b) launch of a new process or program celebrating success and everything that was done to achieve it e.g. ISO Certification, c) focus on one area, such as a Fall Protection, Hand Safety, Stress Management Week, etc. and d) Wellness or Health.

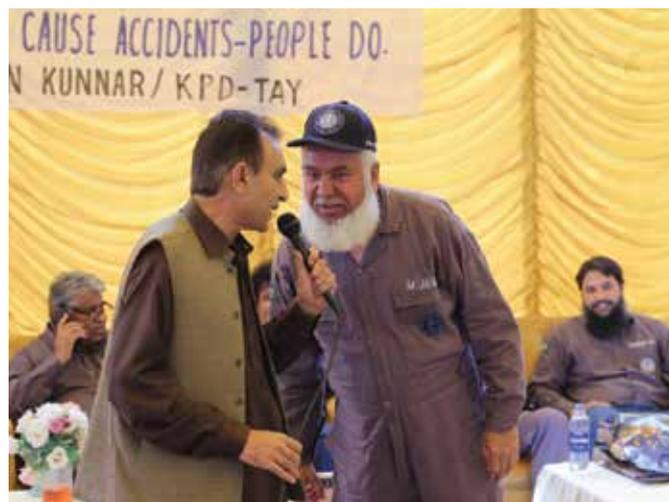
Safety walk, quizzes and contests like message-oriented poster competition, scenario-based emergency mockup drills, hazards hunt program etc. were planned to instill & reinforce positive behavior-based awareness plus motivation amongst the personnel and subsequently, to click HSE importance in the operating fields, prizes distributed among the persons who participated in the event in real terms. Certificates also conferred to the personnel and Sections with high HSE performance in year 2021. Ambience of the events was high as personnel's zeal & zest found unmatched. HSE Awareness Events have become another tool towards HSE culture and compliance, especially when we tend to show a measurable benefit to the field and a return on the investment. For example, by picking focus area for the events, the current data of each field was gathered from its Safety Pyramid to have a baseline and in the future events, this will be compared to see the percentage improvement.



GLIMPSES of HSE Awareness Events



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Inovo USA Conducted Certificate Level Training on **Process Hazard Analysis (PHA) Techniques** for Team Leaders

OGDCL HSE team and OGTI engaged Inovo USA to conduct Three (03) days Process Hazard Analysis (PHA) techniques training during January 04-06, 2022 at OGTI training facility, Islamabad. The scope was to cover PSM introduction and lectures on various PHA techniques including; Hazards Identification (HAZID), Hazards & Operability (HAZOP Study), Fault Tree Analysis (FTA), Failure Mode & Effect Analysis (FMEA), What-if Checklist Analysis, Quantitative Risk Assessment (QRA), and Major Accident Hazard (MAH). Group exercises and case studies were also added after each technique for its better understanding according

to oil & gas sector.

Total thirty five (35) OGDCL participants attended the training. The participants were from head office and different fields with considerable experience. The participants were from diversified disciplines including; process engineering, mechanical engineering, instrumentation, production, health safety & quality (HSEQ), and telemetry.

Mr. Kashif Rasheed was the Lead Trainer for the course with his over 20 years of experience in Health, Environment, Occupational & Process Safety Management within Petrochemical, Power, Manufacturing and Consultancy Sectors.

Mr. Bilal Jillani assisted him (as co-trainer) being a Certified Safety Professional with over 13 years Technical, Managerial, Training, and Consultancy Experience.

Participants were evaluated on the basis of class participation, activities, and final exam with 70% passing marks as qualification requirement for Inovo USA International Certificate.

Inovo USA also conducted an awareness session on January 07, 2022 for the participants on Board of Certified Safety Professionals (BCSP) USA Certifications and National Fire Protection Association (NFPA) USA Standards & Electrical Safety Certifications.



An Exclusive Training Conducted at Dakhni on Carbon Footprint Estimation using Fuel Analysis and Mass Balance Approach



of carbon dioxide into the atmosphere. The equivalency scale allows comparison for different greenhouse gases (GHG) based on their global warming potentials (GWP). Carbon dioxide is released primarily from the combustion of fossil fuels. While in an oil and gas industry, methane emissions occur due to fugitive equipment leaks and process vents. Nitrous oxide is produced in trace amounts based on the type of fuel and equipment. An Exclusive Training session on Carbon Footprint Estimation using Fuel Analysis and Mass Balance Approach was conducted by Mr. Jamal Shahid, Environment Engineer at Dakhni Gas Processing Plant, Distt Attock. The 2-day interactive training session was conducted from 09/02/2022 to 10/02/2022. Following topics were covered in the session:

A carbon footprint is defined as the total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO₂). In other words, when we consume

electricity to light / warm up our homes, or when we buy consumer products, we are actually contributing to our carbon footprints because the generation of electrical power and the production of consumer goods release some amount

- Introduction to Carbon Footprint
- Introduction to Greenhouse Gases (GHG): Methane (CH₄), Carbon dioxide(CO₂), Nitrous oxide (N₂O) and Sulphurous oxide(s)
- Causes and Sources of Carbon Footprint and Greenhouse Gases (GHG)
- The Kyoto Protocol (KP) and Greenhouse Gases of Concern
- Impacts of GHG on the Environment
- Identification of Potential GHG Emission Sources in an Oil & Gas Industry
- Carbon Footprints Estimation in the Oil & Gas Industry
- Emissions Estimation Approaches and Considerations followed by Training Exercises

The crucial training session was attended by field participants on a positive note.

Pyrophoric Material: A Fire and Explosion Hazard

Three famous explosions involved pyrophoric materials in storage tanks. The following incidents occurred when pyrophoric materials on the insides of the tank walls ignited when exposed to oxygen in the air:

1. During a rig-out operation, grounded vacuum trucks were pumping out a vented storage tank.

The crew was on a break when the tank exploded, damaging nearby equipment.

2. A crew of workers on a sour-lease site isolated the blanket gas (sweet gas) to a 400-barrel condensate tank so they could remove several valves for maintenance. Hours later, the tank exploded. The blast threw the tank beyond its

enclosure and propelled burning fluids into the surrounding grassy areas.

3. Two connected 750-barrel storage tanks exploded, launching both tank lids more than 50 m (160 ft.). Nearby workers had left the area only a few hours before the explosion and ensuing fire.

What are pyrophoric materials?

- Pyrophoric materials are chemicals that can spontaneously ignite when exposed to air. They are often found in refinery piping, tanks, and vessels. A common pyrophoric material is pyrophoric iron sulfide.
- Pyrophoric iron sulfide is created when iron oxide (rust) is converted into iron sulfide in the presence of hydrogen sulfide. This chemical

reaction only takes place in low oxygen conditions.

- When the pyrophoric iron sulfide particles are exposed to air, they are oxidized back to iron oxide, generating a considerable amount of heat. So much heat is produced that the particles can burn, igniting nearby flammable hydrocarbon gases.

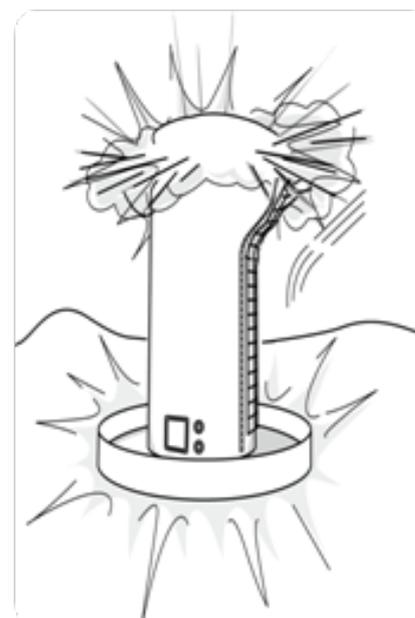
- Fires and explosions caused by pyrophoric materials can occur during shutdowns when tanks or vessels are emptied or equipment and piping are opened for inspections and maintenance.

How did the tanks explode?

Incident reports for these three separate explosions reveal a number of similarities. All the tanks held hydrocarbon condensate with hydrogen sulfide. The tanks also had oxygen-deficient atmospheres. The conditions in all three incidents led to the formation of iron sulfides. When the liquid levels in the tanks dropped, iron sulfide deposits on the tank walls were exposed to the gases inside the tanks. As oxygen entered the tanks (which can occur minutes or even months after the iron sulfides are formed), two things happened:

- The oxygen mixed with the vapors and gases in the tanks to create an explosive atmosphere.
- The oxygen reacted with the pyrophoric iron sulfide to provide a source of ignition. The pyrophoric iron sulfide then ignited the explosive atmosphere, leading to severe damage but, fortunately, no injuries.

Tanks that remain empty for an extended time can still be hazardous. Pyrophoric iron sulfide can remain on tank walls for long periods of time before finally igniting when exposed to oxygen.



How did the tanks explode?

1. Implement and follow a fire and explosion management plan and safe work procedures when emptying tanks and vessels. The plan and procedures should address ignition sources, oxygen, and fuel sources.

2. Consider possible ignition sources, including the following:

- Pyrophoric materials that can form in both sour and sweet sites
- Automatic flare stack igniters
- Electrical discharge from improper bonding/grounding
- Lightning
- Hot work

3. Consider how oxygen could enter the tank. Possible entry points include the following:

- The thief hatch
- An extinguished flare stack
- The level indicator
- Open valves, piping, and hatches
- The heater, thermostat, and anode ports

4. Inert the tank with a gas that does not burn, such as carbon dioxide or nitrogen. Once a flammable blanket gas is shut off, the amount of oxygen in the tank may increase until an explosive gas mixture is created. Inerting the tank may help prevent an explosive atmosphere from

developing.

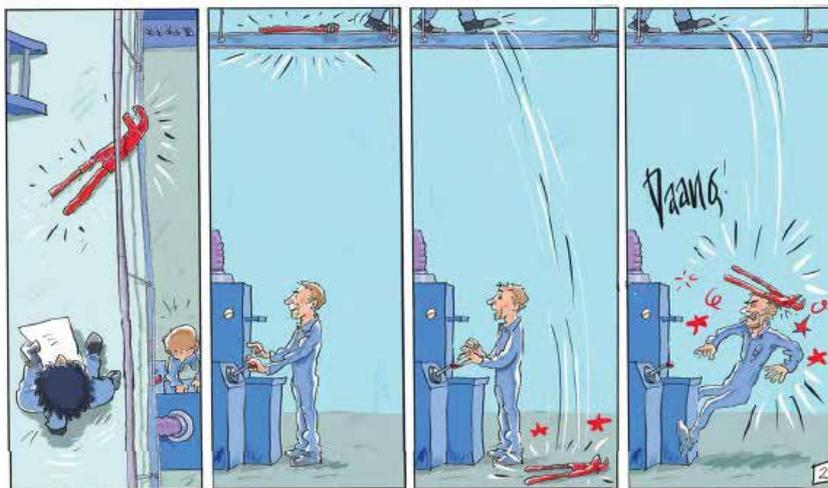
5. Maintain and inspect the inner linings of storage tanks regularly.

6. Consider a chemical treatment to remove pyrophoric materials when you empty a tank:

- Use acid cleaning.
- Add a hydrogen sulfide suppressant to scrub or convert hydrogen sulfide gas.
- Dissolve sulfide deposits using a high pH

chelating solution.

- Add an oxidizing chemical to oxidize the iron sulfide. Oxidizing chemicals include sodium hypochlorite, hydrogen peroxide, and potassium permanganate.



Unsafe Condition

Unsafe Act

Near Miss

Incident

Public Hearing-I

Environmental Impact Assessment of Sara West Development Project, District Ghotki, Sindh

OGDCL conducted Environmental Impact Assessment (EIA) of Sara West Development Project, District Ghotki, Sindh. Sara West Field is located about 45 km east of Daharki town. Sara West field is a low heating value gas field located in East Badin Extension Block B in District Ghotki in the north eastern part of Sindh province. The discovery of well Sara West-1 was made in 1996. To appraise the field, OGDCL drilled and tested 3 wells Sara West 2, 3, and 4 in 2007, 2008, and 2013 respectively. As per the latest reservoir study, the recoverable reserves are 458 BCF. The field has a low calorific value gas with an average heating value of 130 Btu/Scf with a gas containing 63% CO₂ and 23% N₂. In one of the DST conducted on Sara West 3, about 11

ppm, H₂S was also detected in the produced gas. OGDCL is planning to develop the field by installing Gas Processing Plant to produce sales gas that can be offered for power generation purposes. The EIA report identifies potential environmental impacts and provides mitigation measure to minimize impacts. In this regard, a public hearing was conducted by the Sindh EPA at 1130 hours on 10th January, 2022 at project site, Rajey Khan Mahar Otaq, Taluka Daharki, District Ghotki. Project Consultant M/s NCP presented the EIA study findings and EMP. The general public, concerned citizens, civil society organizations and all the stakeholders attended the public hearing. Mr. Ashfaq Ali DCE HSEQ along with Project Rep. and Regional Coordinator

participated in the hearing and replied to the locals' queries. Director EPA Sind acknowledged the initiative of OGDCL and concluded that the project will not pose negative impacts on environment if EMP is followed.



Public Hearing-II

Environmental Impact Assessment of Installation of Gas Processing Facility at Khewari Field, District Khairpur, Sindh

OGDCL conducted Environmental Impact Assessment (EIA) of Installation of Gas Processing Facility at Khewari Field, District Khairpur, Sindh. The proposed project is to install gas processing facility at its Khewari field to deliver the pipeline quality gas to the buyers. The proposed facilities consist of raw gas production of around 30.0 MMSCFD. Raw gas contains 14.65% Carbon Dioxide (CO₂) and about 4-13 ppm Hydrogen Sulfide (H₂S). The EIA report identifies potential environmental impacts and provides mitigation measure to minimize impacts. In this regard, a public hearing was conducted by the Sindh EPA at 1030 hours on

25th March 2022 at Khalid Rajpar Otaq (Bethak). Shop#63, Chundiko, Sanghar Road, Union Council Khewari, Taluka Nara. Project Consultant M/s SGS presented the EIA study findings and EMP. The general public, concerned citizens, civil society organizations and all the stakeholders attended the public hearing. Mr. Ashfaq Ali DCE HSEQ along with Project Rep. and Regional Coordinator participated in the hearing and replied to the locals' queries. Director EPA Sind acknowledged the initiative of OGDCL and concluded that the project will not pose negative impacts on environment if EMP is followed.



Public Hearing-III

Environmental Impact Assessment of Development of Daru Central Oil & Gas Processing Facility, District Tando Muhammad Khan, Sindh

OGDCL conducted Environmental Impact Assessment (EIA) of Development of Daru Central Oil & Gas Processing Facility, Nim Block District Tando Muhammad Khan, Sindh. The proposed project is relocation of Kunnar LPG Plant (non-operational) to Daru Central Processing Facility for utilization and LPG Production. The LPG Plant has approximately 14 MMSCFD raw gas handling capacity and its name-plate Production capacity is 35-40 metric tons per day (MTPD) of Liquefied Petroleum Gas (LPG). The EIA report identifies potential environmental impacts and provides mitigation measure to minimize impact s. In this regard, a public

hearing was conducted by the Sindh EPA at 1030 hours on 28th March 2022 at project site, Tando Muhammad Khan. Project Consultant M/s SGS presented the EIA study findings and EMP. The general public, concerned citizens, civil society organizations and all the stakeholders attended the public hearing. Mr. Ashfaq Ali DCE HSEQ along with Project Rep. and Regional Coordinator participated in the hearing and replied to the locals' queries. Director EPA Sind acknowledged the initiative of OGDCL and concluded that the project will not pose negative impacts on environment if EMP is followed.



New National Parks, Conservancies and Sites to protect wildlife, habitat in Pakistan

Taking a major initiative for the conservation of wildlife and its habitats in diverse ecological zones of Khyber Pakhtunkhwa, the KPK government has notified 11 sites as 'protected areas', including three national parks in 2022. **With the declaration of three new national parks, five conservancies and four sites of special scientific interest, the province's protected areas coverage has jumped from the existing 10.22% to 14.91%.** This is a big achievement, and will help enhance the coverage of the province's protected area to 17% in the next few years.

New National Parks: The department of forestry, environment and wildlife, through separate notifications, declared thousands of hectares of land in Malakand, Hazara, Peshawar and Kohat divisions as protected areas under the Khyber Pakhtunkhwa Wildlife and Biodiversity (Protection, Preservation, Conservation and Management) Act, 2015. Under the Act, the national park, conservancy, wildlife sanctuary, site of special scientific interest, wildlife refuge,

biosphere reserve, national natural heritage site and game reserve are called protected areas.

1. 5,236 hectares area in Nizampur area of Nowshera district has been given the status of national park. The area is bounded by Cherat cantt in north, River Indus in South and East and Darra Adamkhel area of Kohat district in the west.
2. In Mansehra, district, 19971.76 acres of reserve forests in Malkand area of Mansehra district has been notified as national park. The area is bound by Kaghan valley in the north, Balakot city in the south, Matchiara National Park of Azad Jammu and Kashmir in East and Souna Guzara Forest, River Kunhar in the west.
3. An area of 5455.82 acres of land in Kamal Ban area of Mansehra district has been declared as national park. The area is surrounded by Pattan Dais Guzara forest in north, Jarid Guzara forest in south, River Kunhar in east and Souna Guzara forest in the west.

New Conservancies: Besides, the department also notified five conservancies in different areas of the province including Mankial conser-

vancy in Swat which is spread over an area of 20,380 hectares, Kalam conservancy over an area of 109,898 hectares, Terich Torkhow conservancy in Upper Chitral over an area of 262,228 hectares. Besides, the picturesque Kumrat valley in Upper Dir over an area of 27,056 hectares and Dir Kohistan also in Upper Dir over an area of 29,742 hectares have also been declared conservancies.

New Special Sites: In addition, four sites of special scientific interest have also been notified by the department in Buner, Swat and Haripur districts.

Being a signatory to the UN Convention on Biological Diversity, Pakistan is to increase protected area to 17% of its total territory by the year 2030 to achieve the long-term conservation of nature with associated ecosystem services and cultural values. Pakistan's total protected area is around 11%. Under the Protected Area Management Plan, the newly-established National Parks Service within the wildlife department would be strengthened.

Process Safety Management Training Course Conducted at Kunnar-KPD

A comprehensive Process Safety Management Training Course was conducted at Kunnar-KPD in January 26-28, 2022. Mr. Muhammad Nouman, C.E. HSEQ, was the Course Facilitator. The course was based on OSHA's PSM Elements and PSRM Model. In the course, participants learned a) how to identify process safety and major accident hazards in facilities and to assess their risks and define critical controls (barriers); b) understand the concepts of static and dynamic barrier management, use of barrier management to analyze process safety and root cause incident investigation; c) characteristics of different types of barriers: hardware (plant), human (people) and organizational (process); d) managing process safety risks, by providing governance and structure in terms of showing commitment of the organization to process safety, understanding hazards & their associated risk, managing risk in operations, maintenance & learning from incidents; and e) good-industry practices related to the individual PSM elements. This standardized course was meant for those responsible for implementing process safety management in their domains (Operations & Maintenance and Design, Reliability & Inspection). The program was based on a mix of interactive lectures, breakout sessions and worked cases.



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JOURNEY MANAGEMENT TRAINING SESSIONS

Journey Management Plan (JMP) is a safety measure to help avoid accident/injury resulting from travelling & transportation. The objective of this program is to ultimately eliminate driving related accidents that cause fatalities and injuries to employees, contractors & third parties and minimize damage to equipment through careful management of all phases of the travelling

process. In order to train the drivers and seismic workforce & invigorate / enhance knowledge, HSEQ Rep. visited Seismic Parties to impart

two-days training session on “Journey Management” as below:

Trainer/Facilitator	Date	Location
Mr. Saleem Akhtar, HSEQ Professional (Chanda/Mela)	04 th & 5 th February, 2022	SP-5
	19 th & 20 th February, 2022	SP-3
	22 nd & 23 rd February, 2022	SP-4



National High Authority instructor was also invited to deliver a lecture on road safety & defensive driving at SP-4. Mr. Mudassar Hussain,



NHA Instructor explained the importance of road safety. He highlighted almost all important points of concern. He appreciated the effort of

field management to enhance the awareness of employees regarding road safety & defensive driving.

CRANE, LIFTING & TUBULAR HANDLING TRAINING CONDUCTED AT LOGISTIC FIELD KOT SARANG



Objective: This lifting operations training course highlighted the safe working principles and controls required to reduce the chances of accidents occurring as a result of lifting operations. It supported meeting legal obligations under the applicable Regulations.

Class Room Presentation:

March 22, 2022

Drills: Lifting of Drilling Materials Using Lifter; Lifting Tools Inspections; & Lifting of Drill Pipes/Casing Using Crane

No. of Participants: 36



SAFETY OUT OF FOCUS

Texax City Refinery Explosion

On 23rd March 2005, an explosion erupted at BP's Texas City refinery, which resulted in 15 fatalities, 180 injured and \$3 billion in damages and legal settlements. It is one of the worst industrial disasters to date. The explosion was caused by the overfilling of the raffinate splitter tower and a blowdown drum releasing hot hydrocarbons. The resulting vapour cloud

ignited, destroying the ISOM unit. This alert describes the events and associated failures which led to this incident, and explores how effective Process Safety Management could have readily prevented the tragedy.

How the incident occurred: At 0205 hours on 23rd March 2005, a hydrocarbon isomerization (ISOM) unit at the Texas City refinery was restarted after being down for maintenance. During start-up, unapproved procedures were followed as the tower was filled over the procedural guideline. The raffinate level was solely determined using the tower's torquetube displacer type level transmitter, which was not calibrated for the specific gravity of the fluid. The operator stopped the filling process after the transmitter indicated a level of 2.7m, whereas the true level was 4m. The informal procedure meant that the high-level alarm (2.3m) was ignored. Additionally, the secondary high-level alarm (2.4m) was faulty, which was not known to the operators. The restart was stopped for the day at that point, which was very unusual. During the day shift briefing, it was decided the restart would be stopped as the heavy raffinate product tanks were full. The day supervisor, who arrived late and missed the briefing, gave the instruction to resume the start-up. The feed into the tower and the recirculation pumps were restarted. However, miscommunication between operators meant that the heavy raffinate outlet was left closed. As a non-continuous restart was abnormal, the day board operator had to rely heavily on the experienced supervisor. Furnaces used to heat the fresh and recirculated feed into the tower were lit as per procedure. Shortly after this, the supervisor left the plant due to a family emergency without assigning a replacement, which was a deviation from protocol. This left the board operator alone to oversee the restart of the ISOM and monitor other units. By this point, the raffinate level reached 20m. At 1156 hours, fuel to the burners was increased further and the raffinate level reached 30m. This was fifteen times the normal level, though the level transmitter indicated a safe level of 2.64m and decreasing. It was not until 1249 hours that the level control valve was fully open, however the level kept increasing. At that point, the level in the tower reached 48m triggering liquid flow into the vapour line. The generated hydrostatic head activated the pressure relief valves near the base of the column, which redirected the flow into a blowdown drum. 195,600 litres of flammable fluid entered the blowdown drum, quickly overfilling and discharging to the atmosphere. The discharged fluid quickly formed a flammable vapour cloud, which was ignited by the backfiring of a nearby diesel truck. The resulting explosion killed 15 and injured 180 people, 12 of whom were in a trailer 37m from the blowdown drum. A summary of the analysis of events that led up to the disaster is shown in Figure.

Shortcomings in Process Safety Management (PSM): PSM is a systematic framework for managing the integrity of hazardous processes. The ultimate goal of a PSM system is to prevent unwanted release of chemicals or energy that could harm people, environment or business. Every company operates a PSM system tailored to their operations, hazards and business strategy. Therefore, it is important to review it regularly for gaps and shortcomings, especially in the context of disasters such as Texas City. The analysis of the disaster highlights several long-term PSM deficiencies that led to devastating safety failures. The deficiencies stem from the lack of commitment from senior leaders (safety leadership, learning culture, process safety matrices) to operational safety (mechanical integrity, operating procedure, MOC), which were identified as key root causes of the accident. Even though many of the shortcomings were identified previously regarding BP's Texas City Refinery, no significant improvements to PSM were made, allowing the disaster to claim 15 lives and injure 180 people.

