**Accident Profile**

**Title**

Fire at the petroleum at refining

**Date/Time of Major Occurrence**

**Start Date**

12-10-2006

**End Date**

12-10-2006

**Accident Type**

Other Event

**Reported under**

EU Seveso I Directive

**Seveso II Status**

Upper tier

**Industrial Activity**

Petrochemical / Oil Refineries

**Reasons for Reporting**

Substances involved: greater than 5% of quantity in Column 3 of Annex I

Injury to persons: >= 1 fatalities, >= 6 hospitalizing injuries, evacuation, shelter-in-place, utility disruption and damage to real estate Immediate damage to the environment (according to Annex VI)

Damage to property: on-site >2M &euro;, off-site > 0.5M &euro; Cross-border damage: transboundary accidents

Interesting for lessons learned.

**Accident Report**

**Accident description**

From 2 to 4 October 2006 repairs were carried out at omissis nafta of the KR‑601/2 furnace in section 001 of the KT-1/1 combined technological device for deep processing of fuel oil; these works consisted of replacing the three worn out sections of the heating spiral in the radiation part of the furnace. After completing the works at 8:00 in the morning of 12 October 2006 the work was begun on starting up the KR-601/2 furnace. The burners were ignited in the KR‑601/2 furnace, the temperature was raised and the furnace heating spirals were filled with fuel oil, which began feeding into the K-601 column at 9:28 of the same day. Prior to connecting KR‑601/2 to the system, the raw material was fed into the K-601 column by heating it in the KR-601/1 reserve furnace. The technological parameters of the KR-601/1 furnace and K‑601 column were within the allowed limits. The KR-601/2 furnace was connected to the system by gradually raising the temperature of the raw material supplied to the column. According to the technical regulation of the vacuum fuel oil rectification and tar visbreaking section 001 of the combined technological device KT-1/1 for deep processing of fuel oil, the temperature of the supplied raw material needs to be raised by 30 to 35°C per hour. It is apparent from the analysis of the diagrams of technological parameters that from 12:55 to 14:24 the temperature of the raw material being supplied was rising by 38 to 45°C per hour, meaning that the limits specified in the technical regulation were being exceeded. Certain other divergences from the technological regime can be seen from the diagrams of the parameters of the

technological regime: - at 9:32 and at 9:48 the vacuum pressure in the column decreased to 104.435 mm Hg st. and 67.018 mm Hg st. respectively (usually the vacuum pressure in the column is about 20 mm Hg st.); - from 13:37 the level of tar started decreasing sharply at the bottom of the K‑601 column, and at 14:24 the measuring devices could not register it at all. According to the technical regulation, the level of tar at the bottom of the column must remain within the limits of 40 to 90%; - from 14:00 to 14:23 the pressure of the cleavage gas in separators SP-603/1 and SP-603/2 started increasing sharply (from 0.53 bar. to -0.335 bar.);

- from 10:55 to 12:25 the total amount of raw material being fed into the K-601 column was about 544 m3/h. At 13:55 the amount of the raw material being supplied decreased to 447 m3/h. The debit was increased, and at 14:25 the amount of the raw material being fed into the column was 520 m3/h. At 14:30 the supply of the raw material into the column stopped completely . - At 14:24 there was a complete absence of vacuum pressure in the K-601 column; - At 14:30 the S-608 pump stopped pumping and was operating an empty cycle. The Communication Point of the Operative Management Section of the Fire Rescue Service of omissis received the fire alarm from the K-601 column at 14:32 after the fire safety alarm was set in bases Nos 6 and 7 of section 001. The firefighters on duty in team 1 of the omissis Fire Safety Service were the first to begin extinguishing the fire in section 001, using fire rescue truck PA- 40(131)137. The remaining firefighters in team 1 and team 2 were immediately sent to site of the fire.

When the first of those teams arrived at the site at 14:36 the column and an area covering 200 sq.m. at the bottom of the column were alight. When the column collapsed at 14:54 the fire spread across an area of 800 sq. m.

**Accident involving**

Domino effects Natech events Transboundary effects Contractors

**Site and installation**

**Site description**

Omissis is an oil processing company engaged in the wholesale of solid, liquid and gaseous fuel and similar products and their transportation by road, rail and pipeline. The company produces fuels for transport, energy and heating purposes. The product range in 2006 was as follows: - petrol (of types 92, 95, 95 with bio-ETBE and 98) - diesel (incl. arctic, agricultural) and furnace fuel; - biodiesel; - aviation fuel (Jet A1); - fuel oil; - bitumen (road, roof); - liquefied gas (vehicle and domestic); - elemental sulphur; - isomerisate (gas component). Capacities – 10 mln tonnes of oil per year. The production premises cover 531 043 sq.m. and the administrative premises cover 15 574 sq.m. The number of employees within the hazardous site: - total - 2211; - day shift - 1284; - night shift - 273. Production and technology facilities operate in three shifts. Hazardous materials: - petrol - 269132 t - diesel - 104848 t - methyl spirit - 530 t - methyl tretbuthyl ether - 8804 t - monoethanolamine- 507.7 t - jet fuel - 50928 t - liquefied oil gas - 6190 t and other (a total of 33 types of hazardous materials). Units within the hazardous site: - Production unit No 1 (primary oil processing); - Production unit No 2 (deep fuel oil processing, production of petrol additives, such as ethyl tretbuthyl ether/methyl tretbuthyl ether (MTBE/ETBE) and hydrogen); - Production unit No 3 (production of bitumen and elemental sulphur and storage of reagents); - Products and raw materials unit (storage of oil, oil products and liquefied gas); - Oil product loading unit (loading and unloading of production to and from tanks and road-tankers); - heating power station; - cleaning equipment facility (industrial waste water treatment, collection of oil products, supply of water for circulation and fire safety purposes).

**Installation/Unit description**

KT-1/1 combined technological device for deep processing of fuel oil of omissis (the complex) connects the vacuum rectification of fuel oil, tar visbreaking, vacuum distillate hydro-purification, stabilization of catalytic cracking products, absorption and fractioning, stabile cracking petrol, visbreaking petrol and butane-butene fraction demercaptanization, methyl tretbuthyl ether (MTBE) or ethyl tretbuthyl ether (ETBE) production, hydrocarbon gas purification with monoethanolamine (MEA) solution processes into a single technological process. In addition to the technological processes referred above, the utilization of gas heat and heat of technological flows resulting from the process of regeneration of catalytic cracking and operation of tubular furnaces is foreseen in the technological device. The KT-1/1 combined technological device was put into operation in 1989. The KT-1/1 combined technological device for deep processing of fuel oil consists of the following administrative devices: - device No1 – technological devices for vacuum rectification of fuel oil and tar visbreaking (001 section); - device No2 – technological device for hydro- purification of vacuum distillate with a block of hydrocarbon and hydrogen gas purification monoethanolamine solution (section 100) and a technological device for MTBE or ETBE production; - device No3 – technological device for catalytic cracking, rectification, absorption and gas fractioning with a block for purification of sulphur compounds from technological condensate (section 200/300); - device No4 – technological device for heat utilization and heating systems (section 400). The following oil products are derived from the KT-1/1 combined technological complex: 1. stable catalytically cracked gasoline – vehicle petrol component; 2. propane-propene and buthane-buthene fraction – raw material derived from alkylation, MTBE (ETBE) production, oligomerisation and petrochemical processes or components of liquefied trade oil gas; 3. methyl tretbuthyl ether (MTBE) or ethyl tretbuthyl ether or a combination of ethers – multi-octane petrol component; 4. diesel distillates – vacuum distillate hydro- purifying diesel distillate (fraction 160‑370 oC), catalytic cracking light diesel distillate (fr. 160-300 oC) and heavy diesel distillate (fr. 300-500 oC), visbreaking light diesel distillate (fr. 160-390 oC) and heavy diesel distillate (fr. 260-380 oC), diesel distillate from vacuum rectification (fr. up to 360 oC), directed for further processing; 5. fraction 310-420 oC and fraction exceeding 420 oC – components of heating fuel oil;

6. stabile secondary petrol – vacuum distillate hydro-purification and visbreaking petrol distillate, directed for further processing (hydrogenation and catalytic reforming); 7. hydrocarbon gas used in the form of gas fuel for technological purposes; 8. hydrogen sulphide in monoethanolamine solution; 9. visbreaking fraction exceeding 350 oC - heating fuel oil component. Object of the accident – the fuel oil vacuum rectification K-601 column in the 001 section of the KT-1/1 combined technological device for deep processing of fuel oil was mounted in September 1988. The column was put into operation in April 1989.

The height of the column is 37 meters and the diameter is 5.5-8.8-5.5 meters. Its general purpose is to increase the output of the light oil products. Primary (atmospheric) fuel oil, the raw material of the vacuum rectification process of fuel oil, is supplied to furnaces KR-601/1,2 by S-601/1,2,R pumps via feedwater heaters by two flows. The partially evaporated fuel oil that is heated in furnaces then enters into K-601 vacuum column by two transfer pipelines. Four load layers are mounted in the K‑601 column. A chute-type humidifier is mounted over the third load layer and sprayer humidifiers are installed over other load layers. Tare, which is the product resulting from the K-601 column, is extracted from the device by S-608/1,2 and S-613/1,r pumps for further processing. The cleavage gas from the top of the column is cooled and enters into separators SP-603/1,2, and subsequently to the fuel gas line. The diesel fraction is retracted from the upper part of the column and the vacuum distillate – from the middle part. Vacuum in the K-601 column is formed by special vacuum formers (ejectors), by using diesel as a working reagent.

**Process**

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| --- | --- |
| **Major occurrences** | **Equipment Type** |
| physical operations (mixing, melting crystallizing, etc.) | reaction vessel; pressurised |

|  |  |
| --- | --- |
| **Initiating Events** | **Equipment Type** |
|  |  |

**Substances**

**Substances Involved**

**Substances Classification**

00. NAMED SUBSTANCE

**Substances detail**

|  |  |  |  |
| --- | --- | --- | --- |
| **Substance** | **CAS Number** | **Quantities (t.)** | |
| **Involved** | **Potential** |
|  |  |  |  |

**Causes**

The commission found during the investigation that, according to the drawing contained in the technical passport of the K-601 column, the 150 mm long junction pipe at the bottom of the column ends with a coupling junction, however, the junction pipe is actually mounted by connecting it to the technological pipeline No 619/1 with a welded connection. These technical modifications are not shown in the drawings of the technical passport of the K-601 column. It was found during the investigation that the design solution to replace the coupling junction with a connection by welding was adopted and approved in 1987. On the basis of the same solution, the steal containing 5% Cr and 0.5% Mo (steal type according to GOST 5520- 79), as foreseen in the initial project for the production from the 426 x 10 pipe of the elements of the technological pipeline No 619/1 connected to the junction pipe of the K‑601 column, was replaced by carbonic construction steal 22K, according to GOST 5520-79. According to the globally recognised methods against corrosion, if the technological product sulphur content exceeds 0.5% and the product temperature exceeds 260 0C, corrosion and heat-proof metal must be used (as was foreseen in the initial project). As the technological product sulphur content of the K-601 column and the product temperature highly exceeds the values referred above (2.6% and 625 0C accordingly), it can be stated that the replacement of the type of steal was an inadequate solution that resulted in the corrosion of the pipeline

No 619/1. This is confirmed by tests carried out during the investigation, according to which, the metal of the wall of the separated pipe in the pipeline No 619/1, between the parts of the vacuum column and the separation valve, is affected by inter‑crystal corrosion and bottom layer erosion (corrosion). The investigated parts of the technological pipeline No 619/1 were affected by erosion (corrosion) at the time of operation and up to the moment of fire. It is likely that the thinning of different walls of the pipe was

predicated by erosion (corrosion) before the fire. The thickness of the wall in some places was only 0.15 mm. It was found during the investigation that, at the moment when the fire was detected and during the extinguishing of the initial fire, it was the bottom part of the K-601 column, located in the intermediary area of the pedestal of the K-601 column and between feedwater heaters of the column and section 001 of the KT 1/1 technological device that was on fire. According to the opinion of the investigating commission, the most likely reason for the fire in the section 001 of the KT 1/1 combined technological device for deep processing of fuel oil is the ignition of the technological product (tar), previously heated to the self‑incineration temperature, after this product burst out through the crack (or cracks) in the part affected by corrosion of the technological pipeline No 619/1 between the junction pipe of the K-601 column and the separating valve. Such cracks may have resulted from the thinning of the wall in the part of the said pipeline to the level that it was not able to resist the pressure load. It results from the analysis of the technical regulation of the vacuum fuel oil rectification and tar visbreaking 001 section of the combined technological device KT-1/1 for deep processing of fuel oil, that the actions of the technological staff faced with changes in technological parameters (tar level at the bottom of the K-601 column (the cube) or vacuum level inside the column K-601) and their technological management are not strictly regulated and the technological staff operating the device acts on the basis of instructions from their directors or based on their own personal experience. At the time of the accident the staff operating the device notices any change in technological parameters (decrease of the tar level at the bottom of the column and sudden decrease of vacuum in the column itself) attempted to restore the parameters, by regulating the column load and the tar debit from the bottom of the column, but at that time the product was already coming through the possible place of dehermetisation in the part of the technological pipeline No 619/1 between the K-601 column junction pipe and the separating valve. It has almost been an hour (from 13:37 to 14:30) that no one of the operating personnel passed through the K-601 column and inspected it or the related equipment, in order to identify the reasons for the decreased tar level in the cube of the K-601 column. On 15 October 2004 the management plans approved by the chairperson of the board of omissis provided for the reduction of operating costs, by extending the intervals between general repairs by at least 4 years and more, and, at the same time, for the improvement of the long-term reliability of devices. According to the commission, this decision fails to improve the long-term reliability of devices, as the repairs of separate devices, without stopping the production for general repairs, cannot allow the full taking into account of the wear and tear of the devices and their condition. The last general repairs at omissis were carried out in 2003, and the repairs planned for 2006 were postponed. The manufacturer set a service period of 11 years for the K-601 vacuum column (technical passport of the device, page 129, Table 2 “Technical characteristics”). The inner condition of the K-601 column was inspected on 26 September 1997 together with hydraulic tests. Based on the inspection and test results, also the investigations performed and conclusions presented by the joint stock omissis, omissis decided to extend the period of operation of the column (the fact recorded in the technical passport of the K-601 column). The last inspection of the inner and outer condition of the K-601 column was performed on 9 January 2006 (the fact recorded in the technical passport of the K-601 column). According to the requirements of the Instructions No BM-2 for using pressure vessels, the next date for the inner and outer inspection of the column was set to 9 January 2010, i.e. the planned frequency of the inspections was 4 years. Acting on the basis of the Instruction for the use of pressure pipelines

No BM-4, approved Order No 83 of the deputy director for production technology and capital integration of omissis of 23 April 2004, the pipeline maintenance engineer of the Diagnostic Facility performs the technical inspections of the pressure pipeline No619/1 (from the K-601 column to the pumps S-608, S- 613/1, S-613/2). The last inspection of the operating pipeline No 619/1 (hereinafter referred to as IOP) and the full verification of its technical condition (hereinafter referred to as VTC) was performed on 15 December 2004. The inspection found some minor shortcomings, however, it concluded that the repairs of the pipeline were not necessary, and the next inspection dates were set accordingly at 15 December 2008 for IOP and 15 December 2010 for VTC (the fact recorded in the technical passport of the K-601 column).

**Organizational**

|  |  |
| --- | --- |
| **Causative Factor** | **Type** |
| organized procedures |  |
| supervision |  |

|  |  |
| --- | --- |
| design of plant/equipment/system |  |

**Plant/Equipment**

|  |  |
| --- | --- |
| **Causative Factor** | **Type** |
| corrosion/fatigue |  |

**Human**

|  |  |
| --- | --- |
| **Causative Factor** | **Type** |
| operator error | unclear |

**Consequences**

The samples of ambient air in omissis, omissis and omissis villages were taken and their residents were inquired. Based on the results of inspection of ambient air, the concentration of chemicals found (nitrogen dioxide and sulphur dioxide) did not exceed the single limit values allowed by omissis Hygiene Standard HN 35:2002 “Limit Values of Polluting Substances in the Ambient Air of Residential Areas”. None of the employees of omissis or residents of the surrounding areas addressed to omissis hospital reception due to health problems related to the fire at omissis. Neither the ambulance of omissisi had any calls related to this accident. Having regard to the information available, no objective facts demonstrating the consequences to public health of the fire at omissis were found. Having received all the required documentation and calculations from omissis, the officers of the State Environmental Protection Inspectorate and omissis Regional Environmental Protection Department inspected the place of the accident and the related communications and performed the required measurements and laboratory tests. After collecting all the available data it was found that it was only the ambient air that suffered damage, after the pollutants fled into the atmosphere in the result of fire. It was found that 9.13 t of different oil products burned during the fire at omissis and the resulting damage to the environment amounted to omissis 68 864.66 (equivalent approx. to 19900 Euro). Omissis suffered material damage of omissis 530 748 (equivalent approx. to 153700 Euro), i.e. the assets of the corresponding value that no longer fit for purpose were written off the accounting.

**Emergency Response**

30 fire rescue cars and 82 state fire rescue service officers from omissis, omissis and omissis county Fire Safety Services participated in the elimination of the accident and 17 pressure guns were used to extinguish the fire.

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| --- | --- | --- |
| **Emergency Response** | **Quantity** | **Quantity/Effect** |
| On-site systems |  |  |
| Off-site external services |  |  |
| Sheltering |  |  |
| Evacuation |  |  |
| Other |  |  |

|  |  |  |
| --- | --- | --- |
| **Remedial Measure** | **Quantity** | **Quantity/Effect** |
| Decontamination |  |  |
| Restoration |  |  |
| Other |  |  |

**Lessons Learned**

**Theme of the Lessons Learned**

Causes - Plant/Equipment

Causes - Human

Causes - Organisational

**Lessons Learned**

In order to avoid similar accidents in future, the following recommendations were given: 1. It is necessary to supplement the technological regulations, by foreseeing particular (defined) actions of the staff and necessary measures to be taken in the event of change in technological parameters and disruption of technological processes. 2. The control of evaluation of technical condition of pipelines, detection of shortcomings and violations, regulation of application of diagnostic measures and methods, elimination of defects and violations and procedures for carrying out repairs was strengthened. 3. In order to ensure safe operation of technological equipment for oil processing, prepare studies for the risk analysis of possible accidents at omissis, clarify accident elimination plans and the safety report. 4. In order to ensure safe operation of technological devices for oil processing, cover the supporting metal constructions of analogous devices with fire-proof material. 5. The time between repairs of devices may only be prolonged after modernising the device or strengthening the testing and inspection system. 6. Install video monitoring systems of dangerous equipment.

**Event Profile**

**Publication Date**