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# SEVESO: HAZID and Major Accident Scenarios

*Presentation of an approach followed for lpg storage (Slovenia)*

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**MAJOR-ACCIDENT HAZARD IDENTIFICATION AND RISK ASSESSMENT AT BUTAN PLIN**

Ref. REAP assignment RPS/BKH – PM 2002: Planning for Emergencies Involving Dangerous Substances for Slovenia

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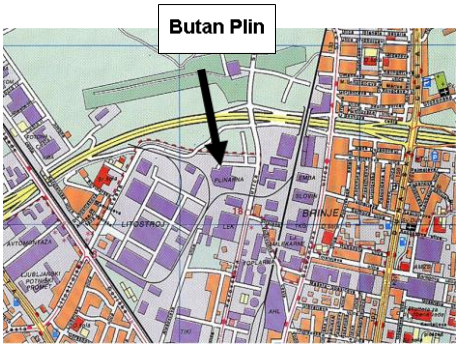
The establishment owned by the Butan Plin d.d. is situated in the industrial zone Šiška in northern part of Ljubljana

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*Vertical LPG Storage Vessels (250m³)*

*Railway Car unloading Station*

*View of Site from Top of Vertical Storage Vessels*

*Cylinder Filling Station*

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***Neighbouring Facilities***

The establishment owned by the Butan Plin d.d. is situated in the industrial zone Šiška in northern part of Ljubljana.
There are various other industrial sites and local infrastructure within 500m of the establishment.
Immediately to the west side of the establishment there is large industrial site Litostroj, which consists of various smaller industrial companies.
Lek d.d., a pharmaceutical company is situated to the south of the site, very close to the railway cars unloading station.
On the east side of the establishment there are a number of industrial sites which include Toplarna Šiška (methane fired power and heating station for northern part of Ljubljana), EMBA, Slovin, TKG, Ljubljanske Mlekarne, AHL, TIKI, etc.

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## 1. Inventory → SEVESO Upper Tier site

***Maximum amounts of dangerous substances present at the Butan Plin d.d. establishment, related to the SEVESO II Directive***
the establishment has a maximum amount of approximately 4,000m³ or approximately 2,200 tonnes of LPG, thus determining it as Seveso II upper tier site as it exceeds the threshold quantity of 200 tonnes.

| | | | | | Low Tier | Upper Tier | Relative quotient | |
|---|---|---|---|---|---|---|---|---|
| # | Source - location | Substance | Volume (m³) | Amount (tonnes) | Seveso II Limit (tonnes) | | Low tier | Upper tier |
| 1 | Two horizontal tanks, 2×250 m³ | Propane | 500 | 275 | 50 | 200 | 5.5 | 1.375 |
| 2 | Two batteries of vertical tanks, 12×250 m³ | LPG | 3000 | 1650 | 50 | 200 | 33 | 8.25 |
| 3 | Horizontal tanks, 6×60 m³ | LPG | 360 | 198 | 50 | 200 | 3.96 | 0.99 |
| 4 | Full LPG bottles, each 10kg, 5000 pieces | LPG | 123.5 | 68 | 50 | 200 | 1.36 | 0.34 |
| 5 | Empty LPG bottles, each 10kg, 5000 pieces | LPG | 0 | 0 | 50 | 200 | 0.000 | 0.000 |
| 6 | Full LPG bottles, each 35kg, 100 pieces | LPG | 8.4 | 4.62 | 50 | 200 | 0.0924 | 0.0231 |
| 7 | Acetylene gas bottles, 80 pieces | acetylene | 0 | 0.5 | 5 | 50 | 0.100 | 0.010 |
| 8 | Railway car tanks, 6 pieces, each 40 m³ | LPG | 240 | 132 | 50 | 200 | 2.64 | 0.66 |
| | | **Total:** | **4231.90** | **2328.12** | | | **46.65** | **11.95** |

**Remarks:**
•All tanks are considered to be filled up to 100% volume; propane density is 541 kg $m^{-3}$, propane-butane mixture (LPG) density is 550kg $m^{-3}$.
•Normal amounts vary by time, but there is always above 60% of tank capacity.

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**HAZID 1**

A 'Major-Accident Hazard Identification' (HAZID) Study was carried out,
Based on:
A 'Hazard and Operability' (HAZOP) study of the site railway car unloading process carried out in advance of the HAZID. The HAZOP was used as support information for the major-accident hazard review.
It involved extensive discussions whilst reviewing site process and instrumentation drawings (P&IDs).
The attendees at the major-accident HAZID Study also took part in the HAZOP

| Facility personnel in the HAZID study |
|---|
| Operations Manager, Butan Plin |
| Safety Manager, Butan Plin |
| Senior Safety and Process Engineer, Institut "Jožef Stefan". |
| Senior Safety and Process Engineer, Institut "Jožef Stefan". |
| Senior Safety and Process Engineer, PM |
| HAZOP Leader and Scribe, Consultant |



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**HAZID 2**

Only those areas considered to have the potential to generate a major-accident were reviewed, i.e. those areas where a hazard source is present. The activities/ areas at the Butan site in Ljubljana, where there is the potential for a major-accident to occur, are :

Railway Car Unloading;
Transfer to Storage Vessel;
Vessel Storage;
Re-filling of Vessels/Lines following maintenance/vessel entry;
Inter-vessel Transfer;
Cylinder Filling;
Storage of Cylinders;
Filling of Road Tankers;
Natural Gas Metering/Regulating Station.

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**HAZID 3**

The focus of the major-accident hazard identification (HAZID) exercise was to identify the events that may lead to serious danger to human health and/or the environment, immediate or delayed, inside or outside the site. These events include:

Release of flammable material leading to fire;
Release of toxic material;
Explosion;
Runaway reaction potential;
Loss of containment/major spill.

Release of toxic material and runaway reaction potential were not relevant for Butan Plin.

The measures in place to prevent such major-accidents, as well as control equipment and instrumentation were also identified. Where further controls were deemed necessary, recommendations for further action were made.



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**HAZARD SCREENING 1**

The Seveso II Directive (96/82/EC) is concerned with major-accident hazards only. Following hazard identification, hazard screening was carried out for each individual hazard identified by assessing the elements of risk, i.e. likelihood and consequences. A method of hazard ranking, using a risk matrix, was used to identify all credible major-accident hazards. To facilitate this, each identified hazard was assigned a qualitative frequency, consequence and risk

See next slide

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# Frenquency categories for Hazard Screening

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*Definitions of Frequency Categories*

| Category | Definition |
|---|---|
| High (H) | Event has occurred or is expected to occur several times during lifetime of site (20-30 years) |
| Intermediate (I) | Event may occur once during lifetime of site |
| Low (L) | Event is not expected to occur during lifetime of the site but may occur once during operations of all existing similar sites |
| Remote (R) | Event is unlikely to occur throughout all similar sites within a 100 year period of operation at the current level |

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# Consequence categories for Hazard screening

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*Definitions of Consequence Categories*

| **Category** | **Definition** (summary) |
|---|---|
| Catastrophic (C) | Death, irreversible environmental damage or system loss |
| Severe (S) | Severe injury, severe occupational illness, long-term environmental damage or major system damage |
| Minor (M) | Minor injury, minor occupational illness, short-term environmental damage or minor system damage |
| Negligible (N) | Negligible/no injuries, negligible/no occupational illness, negligible/no environmental damage or negligible/no system damage |

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## Risk Categories

•The agreed frequency and consequence categories determined for each hazard are combined, using the following matrix, to qualitatively predict the risk associated with each hazard.

| Frequency | Consequence | | | |
|---|---|---|---|---|
| | Catastrophic (C) | Severe (S) | Minor (M) | Negligible (N) |
| High (H) | 1 | 1 | 2 | 3 |
| Intermediate (I) | 1 | 1 | 2 | 3 |
| Low (L) | 1 | 2 | 3 | 3 |
| Remote (R) | 2 | 3 | 3 | 3 |

1. Indicates a Category 1 (Major-Accident) hazard
2. Indicates a Category 2 (Intermediate Risk) hazard
3. Indicates a Category 3 (Low Risk) hazard

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## MAJOR-ACCIDENT HAZARDS IDENTIFIED

The HAZID process identified five category 1, i.e. major-accident, hazards
These are considered to represent the 'worst credible' scenarios for the site.
These hazards were subjected to further consequence assessment,

| | Major-Accident Hazards |
|---|---|
| 1. | Railway Car Unloading – Hose Failure leading to a release of LPG |
| 1. | Transfer to Vessel – Line Failure leading to a release of LPG |
| 1. | Inter-vessel Transfer – Line Failure leading to a release of LPG |
| 1. | Filling of Road Tanker – Hose Failure leading to a release of LPG |
| 1. | Filling of Road Tanker – Tanker is driven away during loading leading to a release of LPG |

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**MAJOR-ACCIDENT HAZARDS IDENTIFIED**

Each of the major-accident hazards identified involve the release of large quantity of LPG which could lead to a:
Jet flame;
Pool fire;
Vapour cloud explosion/Flash Fire;
Boiling liquid expanding vapour explosion (BLEVE).



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# Example Worst Case Scenarios selection for further evaluation (5)

Following the initial selection process, all category 1 (major-accident) hazards Should be grouped by hazard type, e.g. toxic release or flammable release.
A representative worst case is selected from each hazard group for further evaluation.
The representative worst case is the category 1 hazard with the worst consequence can be referred to as the ***worst credible case***.
(normally used for consequence assessments and LUP)

Category 2 hazard with catastrophic consequences: This selected scenario can be referred to as the ***worst possible case.***

The high frequency/less significant consequence hazards represent the ***worst probable case*** for a site.

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In order to appropriately evaluate their potential consequences, the major-accident hazards (category 1 hazards) identified should be subjected to a further assessment process.
A representative 'worst credible' scenario should be used for evaluation purposes.
**Hose failure**
during railway car unloading, leading to loss of the contents of the railcar (50,000kg), was deemed the single worst credible case due to the quantities of LPG involved.



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A number of category 2 hazards were identified which, although extremely unlikely and categorised as remote in the HAZID, could have catastrophic consequences.
One representative category 2 hazard, failure of a 250m$^3$ LPG storage vessel, leading to the release of the full vessel contents, was assessed for emergency planning purposes only and the results of this evaluation have been passed to the local authority Emergency Response Unit.

This scenario is considered to represent the 'worst possible' scenario for the site.

Extremely unlikely

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In the event of a release of LPG, it is likely that action will be taken which will mitigate the event, i.e. the release will be stopped. Therefore, a short duration release scenario was also assessed in which it was assumed that the release was halted after 1 minute. This scenario is considered to represent the 'worst probable' scenario for the site.



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