

# HAZOP REQUIREMENTS AND INTENTS

## INVESTMENT

Project code

Identification

Issued: date

Issued: Orlen Unipetrol RPA s.r.o.	
Coordinators in sense of 61882:	
Manager (BO resp. customer representative):	State name
Manager (Project manager/PBM):	State name, if make sense
Study leader - Unipetrol (Project manager/PEM):	State name
Study leader - Supplier/sub-supplier:	State name

Enter the variable part according to color		Will verify
Subject of the study:		
Subject of the study	Zvolte položku.	
Is the revision of HAZOP study requested in realization stage before commissioning?	Zvolte položku.	
Intent of the study		
<p>Intent of the HAZOP study is to evaluate all risks connected with hazards and operability of the equipment during normal operation (including utility failure) and abnormal operation (start-up, shut down). The study has to be proceed in accordance with the last edition of ČSN EN 61882 and fulfil requirements stated in this form.</p> <p>It is requested to proceed the approximate evaluation of the risks with use of the risk matrix. The HAZOP study results (including worksheets) have to be clear, simple and understandable. The general understanding have to be possible without knowledge of annexes. It is allowed to use references, but only to original text. Reference must not lead to another reference.</p> <p>The study output will include final report and the annexes (described below) in detail, allowing to anybody with basic knowledge of HAZOP methodology to use the output. The study output have to be in form, which allow to anybody with knowledge of HAZOP methodology proceed revision and extension of HAZOP study.</p>		

<p>The defined representatives of UNIPETROL RPA will have defined number of workdays for the revision of the output before acceptance. If any rejections of comments, then it must be stated with reasoning in extra annex.</p> <p>The final output of the study will be provided in hardcopy in defined number and also in electronic version (editable and locked version).</p>					
<b>Type of record:</b> Full record		<b>Time for comments:</b> ____ days		<b>Hardcopies:</b> ____ copies	
<b>Basic description of the studied subject</b>					
Basic description					
Inlet materials:					
Products:					
Utility:					
<b>Scope of study</b>					
<p>HAZOP study have to meet as minimum the scope defined in following text. Team proceeding the realization have to receive expected requirements and intents in advance as well as background documents in defined advance.</p> <p>Study must cover defined boundaries. The utility supply failure, change of inlet quality and another key defined points will be always evaluated even they are over the boundaries to keep sense of study. The equipment within the boundaries will be completely evaluated including the key safeguards elements.</p>					
HAZOP study boundaries: stated boundaries					
Above the boundaries: studied above boundaries					
Safeguards check during study: Evaluated safeguards					
<b>Minimal requirements on properties, guide words, elements</b>					
<p>HAZOP study have to cover normal operation (including utility supply failure), and also start-up, shut down and emergency shut down. Study have to cover at least scope defined below, adapted to evaluated whole (including manual operations). The basic stated properties and guidewords combinations have to be used at least – see following table.</p>					
	Property	Guide word		Element (example)	Deviation (example)
Normal operation					
1	Pressure	Low/ lower	High/ higher	Furnace XY	Pressure low furnace XY

2	Temperature	Low/ lower	High/ higher			Reaktor AB	Temperature lower reactor AB	
3	Flow	Low/ lower	High/ higher	Reverse	Other than	As well as	Gasoline	Flow as well as gasoline + water
4	Level	Low/ lower	High/ higher			Tank CD	Level low tank CD	
5	Composition/ Qualitative	Other than				Tank EF	Composition other than EF	
6	Maintenance	No	Late	Other than		Pipeline xyz	Maintenance no pipeline xyz	
Utility supply failure								
Cooling water	Electric energy	Process air	Nitrogen	Steam	Natural gas	Heat exchanger AB	Water supply failure heat exchanger AB	
Start – up, shut down, emergency shut down								
1	Pressure	Early		Late	Other than	Pipeline AB	Tlak other than pipeline AB	
2	Temperature					Catalyst D	Temperature other than catalyst D	
3	Flow					Line to XY	Flow early to XY	
4	Level					Column GH	Level late column GH	
5	Composition					Reactor JK	Composition reactor JK other than	
Emergency shutdown								
1	Emergency shutdown node AB	Late				Valve before furnace AB	Emergency shutdown late valve before furnace AB	
Evaluated manual operation:		Zvolte položku.						
<b>Documentation</b>								
<p>Inlet documentation in described detail necessary for understanding of evaluated process will be used. It may depend on requested intent. Always will be available:</p> <ul style="list-style-type: none"> <li>HAZOP requirements and intents (this form - finalized)</li> <li>Node description</li> <li>Drawings (like P&amp;ID etc.)</li> <li>Available process documentation</li> </ul>								

Other requested documentation	Minimal time for preparation of the team on the study: ____ days			
<b>Time estimation</b>				
State the requested deadline. Provider estimates time on realization with requested requirements and intent without mitigation of the study quality. It must be set maximum length of the workshop and frequency of the breaks with accordance with availability and ability of the team and type of realization.		Realization: Zvolte položku.		
Max length of workday: _____ hours	Break after: _____ h			
Number of workdays estimation:	Deadline:			
<b>Node and element definition:</b>				
<p>The HAZOP leader (supplier) splits the whole to smaller logical parts and he will define the studied elements. He has to check the accuracy of basic list of properties and guidewords meanwhile. The representative of the customer check this splitting from point of view of logic and understandability. If necessary the HAZOP Leader (Supplier) have to finalize splitting in sense of accurate representing of the system.</p> <p>The nodes have to be defined in independent list or on beginning of a worksheet. In the node definition have to be stated node number, name of node, basic node description, basic design parameters, used background documents, all evaluated elements and date of realization – see example of node definition in annex B1.</p> <p>It need to be included to the node definition additional properties and guide words, if relevant.</p>				
<b>Minimal requests on structure of HAZOP study output</b>				
<p>The worksheet study output structure has to follow at least the structure in annex B2, then any software may be use to creation. The electronic editable version of the final output has to be editable in common software and it has to be clear enough for revision by anybody with knowledge of HAZOP methodology.</p> <p>For each deviation must be different causes stated independently and the rest of record as well.</p>				
<b>Risk Matrix</b>				
<p>The risk matrix (see annex A1, A2 and B2) must be use for approximate evaluation of the risks during realization of the study. The frequency of the failure will be stated based on table of equipment reliability or based on experience of the team with studied whole. The consequences will be described for worst realistic outcome of event without current safeguard and in accordance with that team will choose at least one category and they will quantify the described consequences severity. The classification must be consistent through</p>				

<p>the all study and all team must participate on it. The team leader have to understand the use and sense of use of matrix and support the team effort during stating of frequencies and severities.</p> <p>The two evaluations are requested. First evaluation states unmitigated risks without consideration of current safeguards. The second evaluation states estimation of mitigation of risks in consideration of stated current safeguards and their reliability. It evaluate, if the current safeguards mitigates risks on acceptable level. If the mitigated risk evaluation state risk above tolerable-acceptable level (TA), then team must define recommendation for mitigation of risk at least to this level.</p>				
<b>Minimal structure of the work team</b>				
<p>The study workshop may be realized only if the minimal team is available at least. The study realization must be suspended if any mandatory member must leave the session for more than 15 minutes. The defined specialists will be available on request for solving of specific problems during realization of the study.</p> <p>The mandatory team is minimally:</p>				
Role	Name	Position		
Process engineer				
process employee (operator, chief operator)				
?				
Study leader				
Scribe				
Specialists on request:		Zvolte položku.		
Role	Name	Position		
?				
acceptable substitute in case of absence				
Role	Name	Position		
?	?	?		
<b>Revision</b>				
<p>The output will be revised by stated departments. The revision is mainly intended to check of crucial parts of the HAZOP study output, which could be reason to rejection of output, if they would be in insufficient quality.</p>				
Department		Name		

?				
<b>Final report and study outcome</b>				
<p>The final report have to include all parts and information defined in this form. It will include at least following sections with stated details:</p> <ul style="list-style-type: none"> <li>• Summary – who, for who and why is the study processed by</li> <li>• Introduction – information about project, evaluated unit and processed material <ul style="list-style-type: none"> <li>- Short summary of HAZOP methodology</li> </ul> </li> <li>• Scope of study <ul style="list-style-type: none"> <li>- Detail information about requirements and intents (scope, type of record, boundaries...)</li> <li>- List of basic properties and guide words</li> <li>- List of studied elements</li> <li>- Used risk matrix with explanation</li> </ul> </li> <li>• Team structure <ul style="list-style-type: none"> <li>- Information about team structure – role, name, position</li> <li>- Attendance list</li> </ul> </li> <li>• Mandatory annexes (if the information are not in incorporated in final report)) <ul style="list-style-type: none"> <li>- HAZOP worksheets</li> <li>- List of recommendation (see annex B3)</li> <li>- List of nodes descriptions (if the detail descriptions are not in head of the each worksheet)</li> <li>- Attendance list</li> <li>- HAZOP requirements and intents (this form)</li> </ul> </li> <li>• Conclusions</li> </ul>				
<b>Organization of realization</b>				
Check days	Zvolte položku.	Zvolte položku.		

## Annex A Risk matrix

### Annex A.1 Risk matrix

Category of consequences (S)			Negligible	Minor	Moderate	Major	Catastrophic
Frequencies of consequences 1/year (P)		Number marking	1	2	3	4	5
Very frequent	$<10^0 - 10^{-1}$	1	TA	TNA	NA	NA	NA
Frequent	$<10^{-1} - 10^{-2}$	2	TA	TNA	TNA	NA	NA
Possible	$<10^{-2} - 10^{-3}$	3	TA	TA	TNA	TNA	NA
Sporadic	$<10^{-3} - 10^{-4}$	4	A	TA	TA	TNA	TNA
Rare	$<10^{-4} - 10^{-5}$	5	A	A	TA	TA	TNA
Very rare	$<10^{-5} - 10^{-6}$	6	A	A	A	TA	TA
Almost impossible	$<10^{-6} - 10^{-7}>$	7	A	A	A	A	A

Note:

- A** Acceptable Risk (theoretically no recommendations are requested, but they may be defined and highlighted)
- TA** Tolerable – Acceptable Risk (ALARP, revision of alternatives)
- TNA** Tolerable – Nonacceptable Risk (must be defined recommendation/s including the defined date of realization)
- NA** Nonacceptable Risk (process must be stop immediately)

Categories of the consequences (S)

Consequences	People	Citizens	Environment	Asset	Reputation
Negligible	no injury	no injury	no effect	to 10 000 €	no impact
Minor	minor injury <i>(not affecting of work performance or without days away from work)</i>	bed smell, noise <i>(no evacuation or first aid)</i>	minor, reported (unit report) <i>(small pollution on equipment site)</i>	to 100 000 €	minor impact <i>(maintaining trust – the possibility of quick trust reinstate with low costs; public awareness may exist)</i>
Moderate	moderate injury, single severe injury <i>(limitation of work performance or absence for few days for full recovery; small, reversible health effects, for example: skin irritation, food poisoning)</i>	minor injury <i>(no evacuation, but first aid needed)</i>	moderate effect <i>(damage or emission to environment, but no lasting effect; violation of single law limit or complaint)</i>	to 1.000 000 €	limited impact <i>(breach of trust – the trust reinstate with long term cooperation with PR, negative attention in local media or attention of political parties)</i>
Major	multiple severe injury <i>(irreversible health effect with large impact to work ability, for example: caustic burs, noise / explosion induced hearing loss, burns)</i>	intermediate injury <i>(limited health impact, without evacuation, medical treatment in single cases)</i>	major effect <i>(necessity of major action from Company to environment recovery; violation of law limits)</i>	to 10 000 000 €	national effect <i>(significant breach of trust - trust can be reinstated, but with significant costs. Negative national media attention)</i>
Catastrophic	fatality <i>(one or more fatalities)</i>	severe injury <i>(irreversible health effects, necessity of evacuation and medical treatment for multiple of people)</i>	ecological catastrophe <i>(persistent, severe damages on environment with large financial consequences for Company; consequences significantly violates law limitations)</i>	more than 10 000 000 €	international effect <i>(permanent significant breach of trust – impossible to fully reinstated; international public attention; large, negative international media attention)</i>

## Annex B

### Annex B.1 Node example

Node number	Description and design condition	Background documents	Equipment	Realized
4. Pyrogas compression GB-201 (1./2./3. stage)	<p>GB-201 provides compression of pyrogas prior to separation. Pyrolysed gas cooled after water separator DA-103 to 25-35 °C (max 45°C) and with overpressure 30-60 kPa continua to separator FA-201. In FA-201 are separated remainings of the liquid before first stage of compressor suction of GB-201. GB-201 has 5 compression stages and final pressure is approximately 3,5 MPa. The minimal flow is set on 141 t/h on third stage of compressor discharge. The compression heats gas and it must be cooled in heat exchangers. Maximal temperature on any stage discharge is 110°C. Polymers formation is rising with rising temperature. Some amount of gas condensate after compression and cooling. The liquid is separate in separator prior next stage of compression.</p> <p>FA-201 – p=0,263 MPa; T=200°C  FA-212 – p = 3,8 MPa; T=150°C  EA-203A/B/C – shell: p = 0,39 MPa; T=120°C;  tubes: p=0,9 MPa; T=60°C  FA-202 – p = 0,39 MPa; T=120°C  FA-203 – p = 0,65 MPa; T=120°C  EA-204A/B – shell: p=0,65MPa; T=120°C  tubes: p=0,9MPa; T=60°C  GA-207/R – p=0,49 MPa; dp=0,197MPa; Q=15m3/h  GT-201X – p=10MPa; T=500°C; Q=215t/h  GB-201 (1°) – p=3,64 MPa, dp=3,6MPa; Q=166800m3/h  GA-202/R - p=0,66MPa; dp=0,15MPa; Q=45m3/h  GB-201 (2° a 3°) – p=3,64 MPa; dp=3,6 MPa; Q=166800m3/h</p>	<p>PID-E7638-6F-0;  HAZOP-2016-Doc No: &amp;AE-S-RX 1002 (EN);  HAZOP-2011-Příloha 2.1;  TR-EJ</p>	<p>FA-201  FA-212  EA-203A/B/C  FA-202/FA-203  EA-204A/B  GA-207/R  GT-201X  GB-201 (1°)  GA-202/R  GB-201 (2° a 3°)</p>	7/12/2020

Node example

## Annex B.2 Example of minimal worksheet structure

The deviation need to have stated always what it is combined from – property, guide word and element see example. Any software is allowed, if the final output will have structure as in this example at least.

Identified cause

Categories (cat.): P – People; C - Citizens; E - Environment; A –Asset; R- Reputation

Node n. 4. Compression of pyrogas GB-201 (1./2./3. stage)/ Stripper DA-201															
N	Deviation	Cause	Consequence	Risk				Current safeguards	Reduced risks				n	Recommendation	Comment
				Kat	F	K	R		Kat	F	K	RR			
1	Pressure lower GB-201	1. Compressor surge	1. potential damage of the machine	A	2	3	TNA	1. Internal vibration monitoring at GB-201	A	3	3	TNA	46.	Install a low pressure trip at the inlet of GB-201 to trip GB-201	
							—	2. Monitoring of rotor displacement				—			
		2. Closed inlet to GB-201	Potential for formation of vacuum at the suction side, potential for damage of upstream equipment leading to loos of containment	P	3	4	TNA		P	3	4	TNA	46.	Install a low pressure trip at the inlet of GB-201 to trip GB-201	
							—		P	3	4	TNA	47.	Perform a SIL allocation for this low pressure trip	

Example of worksheet

### Annex B.3 Example of minimal recommendation list structure

The team doesn't fill in the responsible person and deadline (the team may suggest). The sorting of recommendation must do after realization of the study UNIPETROL customer representative and in case of investment on meeting of UNIPETROL customer representative, UNIPETROL project manager and design supplier. The reduced risk provides information for quicker orientation in recommendations. The NA and TNA risks have to be mitigated.

Node n. 4. Compression of pyrogas GB-201 (1./2./3. stage)/ Stripper DA-201									
Č	Reduced risks				Č	Recommendation	Comment	Responsible person	Deadline
	Cat	F	K	RR					
1	A	3	3	TNA	46.	Install a low pressure trip at the inlet of GB-201 to trip GB-201			
	P	3	4	TNA	46.	Install a low pressure trip at the inlet of GB-201 to trip GB-201			
	P	3	4	TNA	47.	Perform a SIL allocation for this low pressure trip			

*Example of recommendation list*