**ACCIDENT ANALYSIS BENCHMARKING EXERCISE**

**SUMMARY OF RESULTS OF PHASE 1**

*JRC-MAHB has created this form to help you give us a brief update on your team composition and plans for contributing to the benchmarking exercise. The form provides space for periodic updates. One person from the team should volunteer to fill out the form. You may wish to give your team a name, e.g., the Buncefield Team. For each part of the form, use additional space as needed.*

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| **TEAM COMPOSITION, ACCIDENT/METHODS SELECTED, SCHEDULE****DATE: 27 September 2016** |
| **LIST OF TEAM MEMBERS** (*Add rows as necessary)* |
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**Table 1: Description of exercise**

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| **Description of exercise**  | Phase 1 |
| **Description of Method(s) used** | * Timeline tool
* Excel sheet following the STEP model (MW). As I understand it, the STEP model is a timeline combined with an actor. So it is about who or what is responsible and when. STEP (Sequential Timeline Event Plotting) is similar to a swimming lane diagram, with the actors (persons, organizations, equipment etc.) in the “lanes” and time moving from left to right. Logical/temporal relationships between entities are shown by lines. A description of STEP is given [*Chris Johnson's Failure in Safety-Critical Systems: A Handbook of Accident and Incident Reporting, page 452*](http://www.dcs.gla.ac.uk/~johnson/book/)
* ECFA+ – Events and Conditional Factors Analysis, see [here](http://www.nri.eu.com/ecfa.html). An ECFA+ diagram can easily be shaped as a STEP diagram.
* Tripod Beta: see [here](http://publishing.energyinst.org/tripod). Tripod Beta establishes the “natural sequence” of events, identifies barriers that should have stopped that (but were not effective) and explores the reasons for them failing. The Immediate Cause explains the (usual) human (in)action that failed the barrier directly. The Precondition(s) explains why the (non)act in the IC was logical for the person involved in the IC. The Underlying Cause(s) explain the existence of the associated Precondition(s) at system level. UC are farther away from the incident or barrier failure, could exist for a long time. Identifying and addressing them is the ultimate goal of Tripod Beta.
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| **Accident(s) studied** | BuncefieldCzech accident – insufficient information available in the MARS database. |
| **References used by the team, including tools, websites, publications.** | See below in Table 4 |
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| **Expectations of outcomes** | I expected to be able to draw the timeline of the accident with gathering information on the events had occurred pre-accident, too. This information is important to have the sequence of events written. |
| For Buncefield, I expected to have to read through a few sources to make a timeline, especially looking from the perspective of organizational factors. I expected the timeline would generate questions, especially highlight gaps or areas of further analysis for follow-up in the second phase. |
| Problematic is that we use the data in a *completed* investigation. The real value in a tool (compared to others) is how it works *during* an investigation, how it will guide investigators and raise issues. We can’t establish how the Buncefield investigation would look like if we did it with STEP/ECFA+/Tripod Beta etc.. |
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**Table 2: Findings relevant to the accident and report information**

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| **What was the result of this process?****e.g., -findings -questions, gaps in information that you hope to resolve in the next steps -scope of the investigation -limitations imposed by information available -potential themes already emerging -gaps in information** | **How did this phase meet your expectations?** |
| **Scope of the investigation reports:** The reports of the investigation focus on technical factors and some organizational factors. (MW) |
| **Findings from report**: I have found different information from the different reference materials. I found that most information on organizational factors could be found in one source (Buncefield: Why Did It Happen?) and this job was easy. On the other hand, even though a causal situation was described, it was not entirely clear when a particular mistake was made in the chain of events, e.g., when did the supplier fail to provide information that would have indicated maintenance requirements for the safety instrumented system? While organizational factors were well-developed in the documentation that I studied, the influences that affected off-site consequences are not well-discussed. (MW) |
| **Potential themes already emerging:**The choice of a tool and the outcomes depend very much on the Terms of Reference: what are the investigation question, what is the scope and perspective (organizational/temporal), how deep do we need to go (events description, human causes, organizational causes). |
| Lack of attention of the operator to the operational aspects of the safety instrumented systemsPoor communication between the operator, supplier and manufacturer of the safety instrumented systems |
| **Limitations of the report:** It was quite difficult to get information from the past events.Also, the tool Timeline did not make possible to catch all information in its format, I would have needed more room for my thoughts and findings but the tool has its limits.I agree that it was difficult to get information on pre-accident events. |
| **Gaps in information in the reports:** There seem to be documents on consequences off-site, but not that much reflection about how mitigation strategy could be improved. One argument could be that the operator did not expect such an accident, but I think this is a weak argument for any lack of reflection at all. What type of scenarios were envisioned and did they actually have adequate mitigation? Also, the site was an industrial park? How did the site foresee the risk of a domino effect? Was it prepared should it have been prepared? It may be that this information exists and I need to look at the analyses more in-depth. There is a lot of documentation on Buncefield and I did not read all of the reference materials from cover to cover. However, it did strike me that the 2011 reflection in “Buncefield: Why did it happen?” excluded these arguments. (MW)There was no evidence of any risk or criticality analysis, and I think that would be expected from a COMAH site. To what extent was the site inspected by authorities? Was there a Seveso II safety plan with scenarios? (JP)Another question for organizational factors is whether it matters that the timeline is imprecise in regard to what happened before Buncefield. It creates the question as to whether there were opportunities for the operator to identify gaps in information about the functionality and maintenance of the safety instrumented equipment. We don’t really know if the operator or any staff on site, ever considered these questions. We may have to assume that they did not. Again, I will be re-looking at the documentation to see if there are any answers to these questions that I missed. |
| **Questions or gaps in information that you hope to resolve in the next steps :** Pre-accident events and underlying causes or further information on WHY?Look for questions/answers to determine how off-site consequences and domino effects were considered in internal/external emergency response planning and what actually occurred.(MW) But would that have made a difference? The explosion was the big thing, there was little they could do afterwards (except mitigation e.g. leaking bunds). |
| **If you were an investigator or inspector, what questions would you ask the site following this analysis?** |  |
| Why didn’t the supplier and manufacturer communicate better how the safety instrumented equipment worked?Did the process engineer(s) realize that they did not have this information?Did any staff on the site have questions about this?What was the safety awareness of level of staff persons?How well trained were they to understand risks of overload?Were the staff led to assume that the SIS could prevent risks from overloading?What did the operator predict was the worst case?What were the provisions for off-site emergency response for this worst case?Did the operator or operators on site have a domino effects scenario? If so, what were the emergency response plans for this?What scenarios did local authorities use for emergency response planning?To what extent were risks at HOSL identified, evaluated and mitigated?To what extent is critical equipment and procedures identified and their integrity demonstrated (including access security)?How is the integrity of critical equipment warranted and demonstrated (Maintenance Management)?How are incidents/unusual situations (e.g. recurring ATG failure) reported and acted on at a fundamental level (i.e. resolving the problem once and for all)?How are operational personnel trained, especially with respect to risks and critical equipment/procedures?What is the level of operational discipline and management oversight at the site? |

**Table 3: Findings relevant to the method**

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| **Summary of experience working with the method(s)** | I would use this method again. It worked with the information that I found to generate questions and start an analytical framework. |
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| **Advantages** | It has a feature that visualize the timeline as a calendar, which helps in differentiating the different events and the categories (technical or human).Using the Excel file was pretty workable, and maybe in future, I would even just use a Table in Word because it would be more easily printable. |
| **Disadvantages** | When questions pop up, I personally did not find the tool useful, and some sub-categories are not very useful to use.There are sometimes a lot of actions for whom the “agent” (responsible party) is not clear. But on the other hand, this is perhaps an advantage because it points out information that you maybe you should look for or a question that you need to ask the operator. |
| **Advice for analysts/inspectors using this (these) method(s)** | You need to know what you would like to use this tool, for example, if your purpose is only to visualize on a timeline what happened and what event followed the other, this is the perfect tool. However, if you want to see gaps and add your questions, I think this is not the best one for that purpose.Scope of your investigation is important. Despite all the information in the Buncefield reports, if you were looking for something different (e.g., lessons learned for off-site impact mitigation), you wouldn’t find that much. But if you are looking for organizational factors, there is a lot of material.  |

**Table 4: Reference materials - List of Buncefield Report Links**

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| **Date** | **Title** | **Link** | **Comment** |
| 2011 | Buncefield: Why did it happen? | http://www.hse.gov.uk/comah/buncefield/buncefield-report.pdf |  |
| 2005 | Latest photo evidence used in the Buncefield prosecution [38.9MB] | http://www.hse.gov.uk/news/buncefield/evidence/photo160710.zip |  |
|  | Latest video evidence used in the Buncefield prosecution [106MB] | http://www.hse.gov.uk/news/buncefield/evidence/video160710.zip |  |
|  | Evidence Map (showing positions of cameras) | http://www.hse.gov.uk/news/buncefield/evidence-map.htm |  |
|  | Videos that were not used as evidence in the prosecution | http://www.hse.gov.uk/news/buncefield/additional-video.htm |  |
|  | Images that were not used as evidence in the prosecution | http://www.hse.gov.uk/news/buncefield/additional-images.htm |  |
|  | Chronology of events at Buncefield explosion | http://www.hse.gov.uk/news/buncefield/chronology.htm |  |
| 2008 | MIIB Buncefield report - volume 1 | http://www.hse.gov.uk/comah/buncefield/miib-final-volume1.pdf |  |
|  | MIIB Buncefield report - volume 2a | http://www.hse.gov.uk/comah/buncefield/miib-final-volume2a.pdf |  |
|  | MIIB Buncefield report - volume 2b | http://www.hse.gov.uk/comah/buncefield/miib-final-volume2b.pdf |  |
|  |  | http://www.hse.gov.uk/comah/buncefield/oneyear.htm |  |
|  | Buncefield: Hertfordshire Fire and Rescue Service's review of the fire response |  | Book |
| 2006 | New high resolution aerial photo (January 2006) of aftermath at Buncefield depot | http://www.secret-bases.co.uk/secret3.htm#buncefield |  |
| 2005 | Fujifilm Electronic ImagingScenes of the devastation caused by the explosion at the Buncefield Oil Depot on Sunday 12th December 1005. | http://www.jonrb.com/photo/Fujifilm/index.html |  |
| 2006 | BBC News | http://news.bbc.co.uk/2/hi/uk\_news/4525504.stm |  |
| 2015 | Wikipedia Article | https://en.wikipedia.org/wiki/Buncefield\_fire |  |
|  | HOSL | <http://www.hosl.co.uk/about.html> |  |
| 2005 | Initial Report to the Health and Safety Commission andthe Environment Agency of the investigation into theexplosions and fires at the Buncefield oil storage andtransfer depot, Hemel Hempstead, on 11 December 2005 |  |  |
|  | Buncefield incident communityImpact (HSE) | <http://www.hse.gov.uk/news/buncefield/communityimpact.htm>  |  |
|  | Buncefield incident business& economicImpact (HSE) | <http://www.hse.gov.uk/news/buncefield/businessimpact.htm>  |  |