ALIGNING MOD POSMS SAFETY AND POEMS ENVIRONMENTAL RISK APPROACHES – EXPERIENCE AND GUIDANCE

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Abstract

The alignment between safety and environment risk assessment processes has been done for one UK MoD Land Systems defence project and this paper provides a record of that along with guidance on how this alignment may be done for other programmes. The rest of this paper is arranged as follows; section 1 gives an introduction; section 2 looks at the POSMS and POEMS procedure descriptions of severity and likelihood; section 3 considers how the POSMS and POEMS procedures differ in their construction of risk tolerability matrices; and discusses potential issues and difficulties concerned with the alignment process; section 4 describes how the alignment process has been followed through on an existing Land project; and section 5 captures some guiding principles for carrying out future alignment processes in other programmes.

1 Introduction

Strategic guidance in the hazard, risk and impact assessment procedures of the UK defence POEMS [2] and POSMS [3] manuals propose a key alignment opportunity between the risk-based assessment approaches of the safety and environment domains. For example in POEMS EMP03, section 10.2.1 "The key alignment opportunity in EMP03 is to apply a similar risk based approach to establishing the priority of Environmental Features and Safety Hazards."[2] Similarly in SMP04, section 10.2.1 "The key alignment opportunity in POSMS SMP04 is to cross reference Environmental Features against Safety Hazards, so that common issues are identified and where possible assessed together, and also to ensure that the potential environmental impacts of a safety hazard, or the safety impacts of an environmental hazard, are not overlooked."[3]

There are many different ways of carrying out this 'priority based on risk' evaluation, but the methodology outlined in the POEMS EMP03 procedure requires the assessment of the severity of the environmental impact against the frequency and/or duration of that impact. Similarly in POSMS SMP06, the project is instructed to carry out risk estimation to systematically determine the severity of the consequence and the likelihood of occurrence for the hazards and accidents, within each accident sequence. The similarities do give opportunity for alignment that can make the recording, judgement and comparison between personal, equipment and environmental safety that bit more open and auditable.

2 POSMS and POEMS Procedures

Much of this section will be familiar to those working in the UK defence industry, but for those readers who are not; the following will serve as an introduction to them.

The purpose of the procedures is to explain the contents and operation of the Safety Management element of MOD's Acquisition Safety and Environmental Management System (ASEMS). The two elements are known as the Project-Oriented Safety Management System (POSMS) and the Project-Oriented Environmental Management System (POEMS) which has a separate, although closely related, set of information.

The document sets describes the Safety and Environment Management processes and procedures to be employed during a project's life cycle by DE&S and contractors working for them. They enable DE&S project teams to develop and operate at the project level, Safety Management Systems, which are appropriate for discharging their delegated responsibilities and satisfying the requirements defined in Legislation, Departmental Policy and Domain-specific Policy as set by MoD's Functional Safety Boards (FSBs).

The procedures contained within the POSMS and POEMS fall conveniently into three blocks, these are:

- The Core Procedures
- The Support Procedures
- The Assurance and Audit Procedures

The Core Safety Procedures cover the main tasks and activities required by the POSMS. The core procedures consist of 13 separate procedures [3]. In brief outline:

- Procedures SMP01, SMP02 and SMP03 broadly cover collection and collation of relevant information and planning;
- Procedures SMP04 and SMP09 deal with undertaking and reporting Safety Risk Management as part of development;
- Procedure SMP10 relates to Safety Requirements and Contracts;
- SMP11 and SMP12 cover the management of Safety information;
- Procedure SMP13 deals with the in-service Safety Management System, including review of Safety information and preparation for the end of life.

The Core Environment Procedures cover the main tasks and activities required by the POEMS and comprise 8 separate procedures [2]. In brief outline:

- Procedures EMP01, EMP02 and EMP03 broadly cover collection, collation and evaluation of relevant information;
- Procedures EMP04 and EMP05 deal with planning, undertaking and reporting environmental impact assessments;
- Procedures EMP06 and EMP07 cover the development of future Environmental Management Plans;
- Procedure EMP08 covers review and continuous improvement of EMS outputs at specific trigger points.

Throughout both sets of procedures there are frequent references to 'key alignment opportunities' between the environmental and safety domains – e.g. EMP03, EMP04, EMP05, EMP06, SMP04, SMP05, SMP12 [2,3] all refer. One of the opportunities that can be taken is to align the risk tolerability (or risk priority) matrices between the two domains. The key benefits of this can be summarised as follows;

- Common issues are more easily identified and where possible assessed together, and to also to ensure that the potential environmental impact of a safety hazard, or a safety impact of an environmental hazard are not overlooked.
- The engineering judgements required in grading and prioritising safety and environmental risks are done against a clearer and consistent assessment regime, making them easier to challenge, repeat and review.
- Environmental and related safety objectives can be more consistent and compatible, and where possible, they can be achieved by the same mitigation or control action.
- Identification and analysis meetings need not necessarily be separated between safety and environmental specialist working groups, leading to a lower resource requirement.

3 Differences and Difficulties

3.1 Differences in Procedures

The POEMS guidance provides for a project-appropriate risk tolerability matrix, and suggests using a 4x4 or a 6x6 (severity x likelihood) matrix. The guidance linked to POSMS (POSMS itself does not make a formal recommendation on the nature of a risk tolerability matrix, however the linked policy does give an example "which will be tailored to the system" under review [3]) allows for a 4x6 matrix (4 severity categories and 6 likelihood categories). The environmental-based risk matrix uses representative linear scales that are multiplied together, in the larger case, to provide a risk index number (1 to 36). The safety-based risk matrix uses representative logarithmic scales where particular risk combinations are often given letter-based classes (A to D).

In the safety-based matrix 'A' class risks are intolerable, 'D' class risks are broadly acceptable and the two classes between, 'B' and 'C', may be tolerable risks if certain conditions are met. In the environmental-based matrix, it is suggested that risk numbers 24 and above are usually considered intolerable, and those 12 and below are considered broadly acceptable. The risks in between maybe tolerable if certain conditions are met.

3.2 Difficulties in Alignment

The difficulties chiefly arise from the differences noted in the previous section – the matrices are the wrong sizes, the axes are expressed differently and the application of risk tolerability uses diverse processes – 'seems a hopeless business.

However POEMS EMP03 gives hope and opportunity to the duty holder in its guidance. If the team feels that a 6x6 environmental matrix gives too many categories it can choose to reduce this number to 5 or 4 for either axis. Further, if an IPT wants to change either of the threshold scores it may do so, but must provide justification for this.

There are the three steps to go through to achieve alignment – align the number of categories on the two matrices' axes; align the specific meaning of the likelihood and severity definitions; and finally modify the environmental threshold scores to give alignment between the risk categories.

4 Experience of the Alignment Process

4.1 Step 1: Align the order of the matrices

The initial typical POEMS matrix is a 6x6 matrix and the typical POSMS-linked matrix is a 4x6 matrix – generic examples of both are shown in Table 1 and Table 2 below (other examples are available in other domains). The first judgement call came at this point, the severity categories on the POEMS matrix were going to be reduced from six to four, but how was this to be achieved. Our discussion focussed on three options – keep severities 6-to-3; keep severities 4-to-1;

or keep severities 5-to-2. On our particular project we reviewed the preliminary hazard identification results, which just identified the existence of hazards or not. Of course there was no categorisation at this stage, but the safety and environment committee members did have some idea about how bad the hazards might be if they propagated to a full accident event.

FREQUENCY	SEVERITY					
	6	5	4	3	2	1
6	36	30	24	18	12	6
5	30	25	20	15	10	5
4	24	20	16	12	8	4
3	18	15	12	9	6	3
2	12	10	8	6	4	2
1	6	5	4	3	2	1

Table 1: Typical environmental risk tolerability matrix.

	Cat	Crit	Maj	Min
Frequent	A	A	A	B
Probable	A	A	B	C
Occasional	A	B	C	D
Remote	B	C	D	D
Improbable	C	D	D	D
Incredible	D	D	D	D

Table 2: Typical safety risk tolerability matrix.

The preliminary HAZID did enable a judgement on the anticipated severity of the environmental profile of the equipment under analysis. The severity was judged against a simple HIGH, MEDIUM and LOW qualitative scale, with each scale point allocated the appropriate option of the three severity options, each using four interim categories of the POEMS 6 categories.

For our project the committee recommended that the middle 4 categories should be used, i.e. severities 5-to-2. This was justified in that the risk product values still gave a good range of outcomes 30-to-2, instead of 36-to-3 or 24-to-1. Either of these options might have been equally appropriate, however our committee made their choice with reference to the hazard data and the range of risk values. The new POEMS matrix looked as shown in Table 3;

FREQUENCY	SEVERITY				
	5	4	3	2	
6	30	24	18	12	
5	25	20	15	10	
4	20	16	12	8	
3	15	12	9	6	
2	10	8	6	4	
1	5	4	3	2	

Table 3: Reduced order 6x4 environmental matrix.

4.2 Step 2:Align the axes meanings

POEMS process EMP03 instructs that the team needs to assign definitions to all of these categories to make them applicable to their project. These can be based on factors such as resource use, energy use, air emissions, quantities and type of waste produced, scale of environmental impact or persistence of pollution in the environment. The following list can be used as a guide but as the POEMS guidance says, it is not intended to be comprehensive [2]:

a. Negligible
Re-use of material, or negligible use of renewable or non-renewable resources. Produces inert waste. Negligible environmental impact. For example, temporary disturbance of common species only.
b. Minor
Low to medium use of renewable resources or low use of non-renewable resources. Non-special waste produced and recycled, or small amounts disposed of. Notable but limited environmental impact, negligible but widespread. For example, temporary damage to habitat of common species only.
c. Noticeable
Notable to large use of renewable resources, notable use of non-renewable resources. Notable non-special waste disposal, special waste recycled, small amounts of special waste disposal.
Environmental impact limited to a small area, or widespread impact with minimal lasting damage. For example, permanent damage to habitat of common species only.
d. Serious
Significant use of non-renewable resources, limited use of toxic substances. Notable amount of special waste produced. Notable lasting environmental damage. For example, destruction of habitat of common species or temporary damage to habitat of endangered species.
e. Critical
Large scale use of non-renewable resources, significant use of toxic substances. Large amount of special waste produced. Large scale environmental damage with national significance, e.g. release of gases contributing to acid rain (NOx, SOx), or permanent damage to habitat of endangered species.
f. Catastrophic
Large scale use of very scarce resources or toxic resources e.g. use of heavy metals. Very large amount of special waste produced. Severe widespread irreversible environmental damage of international significance e.g. release of greenhouse gases, release of ozone depleting substances or destruction of habitat of endangered species.

For likelihood categories, the highest category for likelihood must be ‘continuous’ and the lowest category ‘occurs rarely, short duration’ e.g. occurs once in the lifetime of the project. Some examples of category choices are [2]:

1 Occurs rarely	1 short duration
2 Annually	2 0 – 5 hours
3 Monthly	3 5 – 50 hours
4 Weekly	4 50 – 500 hours
5 Daily	5 Over 500 hours
6 Continuously	6 Continuously

The POSMS guidance itself doesn't make any recommendation on severity or likelihood categories; rather its advice is to look to the specific safety offices of the Service domain of interest. It says that "Tolerability criteria provide the means for categorising risks as either Unacceptable, Tolerable or Broadly Acceptable. Specific tolerability criteria for a particular domain, function or accident type may be available from Safety Management Offices."[3]

Our specific equipment project came under the Land System Safety Office and the relevant procedure and policy document JSP454 [1]. The severity categories presented there are as shown in Table 4 below;

Label	Persons directly involved e.g. users / maintainers	Person indirectly involved e.g. general public
Catastrophic	Multiple deaths	A single death and/or multiple severe injuries or equivalent occupational illness.
Critical	A single death and /or multiple major injuries or equivalent occupational illness, as defined in RIDDOR 95 Schedule 1.	A single severe injury or occupational illness and/or multiple minor injuries or minor occupational illness.
Marginal	A single major injury or occupational illness and/or multiple minor injuries, as defined in RIDDOR 95 Schedule 1.	At most a single minor injury or minor occupational illness.
Negligible	At most a single minor injury or minor occupational illness. (A non-sporting injury requiring professional medical attention).	Any injury or occupational illness, however minor.

Table 4: JSP454 Severity categories

For likelihood the recommended terminology is as follows in Table 5 [ibid];

Label	Description
Frequent	Likely to be continually experienced during the life of the system
Probable	Likely to occur often during the life of the system
Occasional	Likely to occur several times during the life of the system
Remote	Likely to occur some time during the life of the system
Improbable	Unlikely, but may exceptionally occur during the life of the system
Incredible	Extremely unlikely that the event will occur during the life of the system

Table 5: JSP454 Likelihood categories.

On our project the severity categories were aligned with the middle four of the environmental severities, this was done during debates at committee level and recommended to the project for use by the subject matter experts there. The similar debate on the likelihood categories also produced an aligned recommendation, however much discussion was undertaken concerning the bottom of the scales. The environmental lowest category is once per life of the system – this was judged as broadly equivalent to the second-last category in the safety matrix (may exceptionally occur during the life of the system).At committee level it was judged reasonable to allow broad equivalence between the two likelihood descriptions, but that this should be critically reviewed for continued applicability during future phases of the military acquisition cycle.

The developing joint matrix now looks as follows in Table 6, with the alignment of tolerability boundaries the last step to be accomplished.

		Cat	Crit	Maj	Min
		5	4	3	2
Frequent	6	30	24	18	12
Probable	5	25	20	15	10
Occasional	4	20	16	12	8
Remote	3	15	12	9	6
Improbable	2	10	8	6	4
Incredible	1	5	4	3	2

Table 6: Developed aligned tolerability matrix.

4.3 Step 3: Tolerable Region Boundary Alignment

The original recommended boundary levels in the POEMS guidance were 24 and 12 [2]. To create an aligned arrangement of A-to-D risks, it was a matter of trial and error fitting the risk classes to the new matrix. It was discovered that using 18 and 9 gave the sought after match. The new fully combined matrix, shown below, was agreed at committee level and recommended for use by the hazard and risk analysis group.

		Cat	Crit	Maj	Min
		5	4	3	2
Frequent	6	A/30	A/24	A/18	B/12
Probable	5	A/25	A/20	B/15	C/10
Occasional	4	A/20	B/16	C/12	D/8
Remote	3	B/15	C/12	D/9	D/6
Improbable	2	C/10	D/8	D/6	D/4
Incredible	1	D/5	D/4	D/3	D/2

Table 7: The fully aligned tolerability matrix.

5 Guiding Principles

Of course it may equally be possible to expand the typical safety-based tolerability matrix to match the environmental one. However, this paper considers the specific example of what was done for the project in question. Alignment of risk tolerability matrices does give benefits and tailoring is actively promoted by the process and policy guidance – so it should be sought if possible.

The principle points of guidance to be able to follow an alignment process are as follows;

1. A decision of the rough-order-of-magnitude (ROM) of the environmental impact has to be agreed upon, such that the most appropriate sequence of four severity categories can be chosen for use in the alignment process.

2. An agreement must be argued and reached on the broad equivalence of the likelihood categories between the two domains – particularly towards the lower end of the scale. These are potentially important descriptions as significant attention is generally focussed on high-severity-low-probability events.

3. An agreement must be argues and reached on the tolerability boundary limits within the risk class points of the tolerability matrix.

4. All agreements through the safety committee or safety panel have to be obtained through expert reasoned argument and, most importantly, recorded with justification as evidence for future use, challenge and audit.

References

[1] MoD, JSP 454 Procedures for Land Systems Equipment Safety Assurance, Issue 5, June 2009

[2] MoD, Project Oriented Environmental Management System Manual (POEMS) Release Version 2.2e, November 2009.

[3] Project Oriented Safety Management System Manual (POSMS) Release Version 2.2s, November 2007.

Author Biography

Richard Maguire is Managing Director of a small independent safety assurance company. He has over 15 years experience in safety and risk industries including automotive, petrochemical, defence aviation & land-systems, and civil aviation. His book on Safety Cases & Safety Reports was recently published by Ashgate Limited.