Developing a Heavy Haul Rail Safety Management System

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SUMMARY

With an increasing number of start up Heavy Haul rail operations associated with new mining ventures occurring in the Pilbara there has been a novel requirement for the development of Safety Management Systems (SMS) to meet the requirements of the Rail Safety Act.

The development of the SMS represents some unique challenges in the context of a mining exploration company with little corporate knowledge of what it takes to design, build and run a railway let alone a cutting edge Heavy Haul operation. Fortunately the Office of Rail Safety WA requirements for the SMS can be mapped to the Australian Standard AS4292 Rail Safety Management. This has assisted by providing a comprehensive set of requirements that then form the basis for planning the correct emphasis and details for the development of the Accreditation Application.

Being start up railways long lead time decisions are being made years in advance of the commencement of operations, operating demands are vague and continuously being upgraded, novel technical solutions and suppliers are constantly being presented and considered. The management of risk and time to project completion, including accreditation to design, construct, commission and operate are paramount.

A key decision in the SMS development process was to parallel the organisations own development covering design decisions, construct standards, commissioning tests and finally operating procedures, with an Accreditation Application.

Drawing on the author’s experience in developing the SMS for TPI (Fortescue Metals Group) and API (Aquila) the paper outlines the approach taken to satisfy the requirements of the Office of Rail Safety with an emphasis on highlighting Heavy Haul and start up railway issues that were overcome.

INTRODUCTION

A common set of Safety Accreditation requirements has been agreed to by the rail safety regulators across Australia which is known as National Accreditation Package (NAP) version 2. Essentially the applicant is required to demonstrate capacity and competence to operate a safe railway which maps to the requirements of Australian Standard AS4292 Railway Safety Management. The rail regulators specific requirements are documented in the various Rail Safety Acts and Regulations of each state.

Heavy Haul railways operate at a much higher state of engineering stress than other railways and consequently they have unique risks that need to be addressed in the SMS.

Railways associated with mining projects are uniquely coupled to the logistics chain connecting the mine to the port and generally not operated as a profit centre in their own right. The organisational context of train operations is then as an integrated logistics exercise first and a railway last.

MINING RAILROAD

The development of a railroad in the context of a mining project is unique in that unlike other rail projects the railroad is subset of a much greater development program. Mining railroads are perceived as equivalent to conveyor belts by the principle stakeholders and they cannot believe the breadth of the Act and Regulations that need to be complied with.

Co-regulation in rail is unique in the transport industry and understanding the key concept that your own SMS has the effect of a regulation once accepted by the regulator cannot be emphasised enough.

Heavy Haul

The International Heavy Haul Association describes a heavy haul railroad as one that meets at least two of the following requirements:

- Regularly operates or is contemplating the operation of unit or combined trains of at least 5,000 metric tonnes.
- Regularly operates or is contemplating hauling revenue freight of at least 20 million gross tonnes per year over a given line haul segment comprising at least 150 km in length.
- Regularly operates or is contemplating the operation of equipment with axle loadings of 25 tonnes or more.
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Other distinguishing features of heavy haul railways compared to other railways are:
- Management of the wheel rail interface more closely approaches the technical limits of the materials and,
- The requirement for drivers to manage extraordinary wagon to wagon stress (in train forces) to avoid damaging the rolling stock or even derailing the train.

In Australia the private heavy haul networks are: Pilbara Iron (Hamersley and Robe) run at up to 34 tonne axle load (tal), BHP run at up to 37.5 tal, FMG operate at 40 tal. The publicly owned and operated open access heavy haul networks are: NSW has 30 tal in the core Hunter network, elsewhere in NSW Class 1 lines can generally take 25 tal, and QLD has 26.5 tal in coal working.

Private companies that provide third party access operate in the USA with 32.5 tal with plans to go to 35 tal. South Africa heavy haul railways operate at 26.5 tal. LKAB of Sweden operates on a public network at 30 tal.

Common elements of successful heavy haul railways are:
- Safety is the first priority;
- Trains run to schedule;
- It is part of an integrated logistics chain - Port Mine Rail;
- The train plan is integrated and all processes are aligned to the plan;
- Trains are sized to capacity while balancing the logistics chain;
- Rail and wheels are treated as a system;
- The “Stress-state” of the railways is controlled;
- Quality is built into every aspect of design and operation;
- Employees are engaged in the success of the railway; and
- The public is behind the railway.

Some of these elements are common to all railways but with varying weightings of importance.

Rail Safety Act

The WA Rail Safety Act 2010 and Regulations 2011 have many similarities between section headings of Australian Standard AS4292.1, Railway Safety Management, and the content of a safety management system in the Regulations 2011 Schedule 1. While the Act no longer relies on the AS4292 Standards the Regulator has cross referenced the standard to the Act and Regulation.

There is no provision in the Act for staged accreditation and the approach of the Office of Rail Safety has been to provide conditional accreditation with strict operating scope limitations.

The specific topics that the SMS are to cover are listed in Australian Standard AS4292.1 section 7 as:
- Track and civil infrastructure.
- Electrical infrastructure.
- Rolling stock.
- Signalling and telecommunication systems and equipment.
- Traffic and train management.
- Property access control and protection.
- Railway to railway management.
- Other developments above or below the railway.
- Interface between two track systems.

The accreditation application is typically developed in three phases to match the expansion of physical works and rail safety work:
- Phase 1, Design & Development: Conditional Owner Accreditation for construction of rail earthworks, drainage, sub-ballast, culverts and bridges.
- Phase 2, Rail construction & work trains: Conditional Owner / Operator Accreditation for track work including sleepers, ballast, rail, turnout, construction signals / communication and track work machines.
- Phase 3, Rail Operator and Track Owner: Full Owner / Operator Accreditation for signals / communication, rolling stock and operational systems.

GAP ANALYSIS

The description of the SMS will be the major part of the accreditation application and should be based upon the requirements set out in the Act & Regulations. Initially a list is made of documents that require authoring against the Act requirements. This is essentially a gap analysis. From that list one identifies a number of documents to achieve accreditation. The skill at this stage is to match the scope of the SMS for each phase to the risks to be managed and be prepared to debate your position with the regulator.

At the completion of this work a meeting with the regulator is highly desirable to agree on the scope of the whole SMS and for the phase 1 application. A schedule of development and review for the documents greatly assists the regulator in planning their resources.

At this point in the process there would be a definitive list of documents with a task sheet for each to guide the author on the scope and context of the procedure to be developed.
Key documents then to be carefully worked through when developing the application are:

- Rail Safety Act 2010 & Regulations 2011;
- National Accreditation Package 2.0;
- AS4292 Rail Safety Management;
- AS3931 Risk Assessment of Technological Systems; and

**PHASE ONE DESIGN & DEVELOPMENT**

To receive conditional accreditation to design and construct the railway formation and bridges the organisation will have to complete an application to the regulator which includes:

1. Certification by the Executive Management;
2. Detailed description of the scope and limits of railway activities being undertaken;
3. Description of the assets;
4. Declaration disclosing previous rail history of and key personnel; and
5. Description of the SMS, including the risks associated with the activities and the means applied to eliminate or control the risks.

The regulator would also expect a project brief and a Rail Safety Management Plan of how rail safety will be managed across the entire project life not just the scope of the application. Further key documents to be provided to the regulator and the SMS development team are the Concept of Operations and the Basis of Design for each major component of the railroad. The SMS development team require this to frame the SMS to the railroad risks and the regulator uses these to assess the risks and the competence of the applicant.

![Figure 1: Work trains are the first to operate on the railway.](image)

One of the more difficult set of documents to negotiate are the Safety Interface Coordination Plans between railroad operators. These document how the parties agree to manage safety at the interfaces. The requirements again from AS4292.1, section 7 are summarised as:

- Determination of the functional areas in the railway organizations which will be involved.
- Definition of the point at which each interface occurs.
- The subject matter to be considered and resolved across each interface.
- Determination as to which party agrees to accept responsibility for each of the items detailed in item (c), or each component of an item where there is a spatial or other split of the item.
- What information needs to be obtained by each organization to allow adequate monitoring of the safe operation of the interface.
- Processes for assessing and monitoring the compatibility of engineering and operational parameters.
- Procedures for the review of the interface coordination plan.
- Procedures for access by other parties.

Settling the requirements of interfaces of adjoining railway can result in surprising outcomes such as over-bridge clearances to meet double stack container structure gauge outlines in the Pilbarra. If the organisation has an existing Safety Health and Environment (SHE) management system it is at this stage some translation of requirements for Rail Safety has to be made against the existing processes. Through this process the list of documents to be authored can be reduced but the need is in making sure that the rail requirement is fully met. One needs to be cautious of this approach though because of the nature of co-regulation. That is if the procedure is incorporated in the Rail SMS, even if it resides in the SHE SMS it is treated as a regulation under the Act this can be difficult for some Executives to fully appreciate. At the end of phase one the people and processes are in place to demonstrate competence and capacity to design a railway and build the civil structures.

**Phase One Key Issues**

- Demonstrating competence & capacity of the applicant.
- Before becoming accredited the organisation must finalise a State Agreement to build the railway.
- External Interfaces particularly with other railroads.
- Access to interfacing railroad permanent way for construction purposes.
- Resource constraints of the regulator.
- Rail Camps are covered by the Act.
PHASE TWO RAIL CONSTRUCTION & WORK TRAINS

The second phase is covered by an Application to Vary Accreditation (AVA); which results in conditional accreditation as an Owner / Operator for track work including sleepers, ballast, rail, turnouts, construction signals/communication and track work machines.

At this stage the first of the operating Rail Safety Workers arrive to develop the procedures and rules. Technical heads of the various railway disciplines (rolling stock, permanent way, signal & communications) are progressively added to the organisation.

Operating Risk Assessment

Before commencing any type of rail operations a risk assessment focussed primarily on operational hazards is required. Design and construction will be well advanced and those risks will substantially have been documented in the previous phase.

As the project is still being constructed at this time the risk assessment relies heavily on the expert knowledge and experience of the newly appointed railway personnel.

The zonal risk assessment would include the entire railroad (Mine to Port), and be divided up into the following broad areas for consideration;

- Ore Handling – Loading / Unloading
- Train Traffic Management
- Train Management
- Train Yard Working Operations
- Running sheds
- Permanent Way & Structures
- Maintenance
- Commissioning
- Overview (Entire Corridor & Community)

The assessment also includes identifying the nature and scale of hazards that might occur at commencement of operation. This includes the potential for rail incidents impacting on safety and commercial objectives; effects of natural events such as cyclones, earthquakes, bushfires or local flooding; and the potential for their having significant offsite effects to determine the possible impacts on the surrounding population e.g. Fire.

PHASE THREE RAIL OPERATOR & TRACK OWNER

The third and final phase is again covered by a further Application to Vary Accreditation (AVA); this time to become an Owner / Operator for signals / communication, rolling stock and operational systems.

Hopefully this is the end of the provisional accreditation process and the railroad becomes fully accredited. Although in my experience the...
regulator waits a period after full commissioning before handing over the certificate!

By now the full team of technical and operating personnel are ready to commence operating and the organisation resembles something that is familiar to most railway people.

A new batch of equipment usually arrives at this time covering the equipment needed to maintain and operate the railway including:

- Work trains.
- Fuel & water wagons and freight flat tops to provision the mining areas.
- Track machines covering: Rail grinding/polishing, Track testing car, Tamper, Portable butt welders etc.

Unlike other railways there is a great deal of construction equipment kept on hand to restore the railway rapidly in this remote part of Australia following severe weather events.

Internal Interfaces

Just like any railway there is a tight coupling between technical and performance requirements to be managed between internal technical heads for Rolling stock, Track & Structures, Signals & Communications and Operations. These are of special note in a Heavy Haul railway because it operates at a very highly stressed state i.e. materials and equipment pushed to their limits.

Again the requirements from AS4292:1, section 7 can be paraphrased as:

a. Determine the functional areas inside the railway organisation which will be involved.

b. Definition of the point at which, or limits within which, each interface between parties occurs e.g. wheel rail interface.

c. The subject matter to be considered and resolved across each interface e.g. wheel versus rail head damage versus train loading.

d. Determination as to which party agrees to accept responsibility for each of the items detailed in Item (c), or each component of an item e.g. the person best placed to manage the risk usually is assigned the responsibility.

e. Determination under which assets’ life cycle phase each item is to be considered and, where relevant, the life cycle phases of the interface itself.

f. Determination as to what information needs to be obtained by each functional area at the interface to allow adequate monitoring of the safe operation of the interface e.g. Tribology of wheel and rail.

g. Processes for assessing and monitoring the compatibility of engineering and operational parameters e.g. Expert reviews of proposed standards and maintenance practices.

Phase Three Key Issues

- Internal interfaces. Unless the technical heads come from existing extreme Heavy Haul railways it is unlikely that they appreciate the tight coupling between their disciplines. Joint facilitated risk assessments are essential to gaining a common appreciation of what is being managed.

- Rail Safety Worker recruitment and competence management.

- Community awareness of commencement of rail operations across new level crossings; raised by using local media.

- Commissioning of the track infrastructure and the Ramp Up program to 40t axle load. The risks in the ramp up program are managed through the internal interface risk treatment plan.

CONCLUSION

Development of a Heavy Haul railway SMS on greenfield projects associated with a mining and port operation consist of unique hazards not present to the same degree in other railways.

There is a unique emphasis in a Heavy Haul SMS towards managing internal interfaces but particularly with respect to the wheel rail interface.

A phased approach to provisional accreditation works well in matching the internal development of the railway with its needs to identify and manage risks.

1 www.ihha.net
3 Superseded by AS/NZS ISO 31000:2009 Risk management - Principles and guidelines