

地鐵公司
MTR Corporation

A Holistic Approach to Risk Management

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Agenda

- Business Today & Tomorrow
- Evolution of Risk Management Process
- Risk Management in MTR



Business in the 21st Century

■ Changing Business Environment in HK

Metro



Property



Cable Car



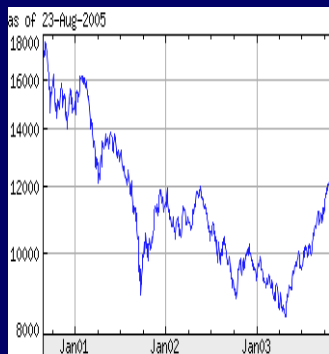
Subsidiaries



Customers



Economy



Politics



Media

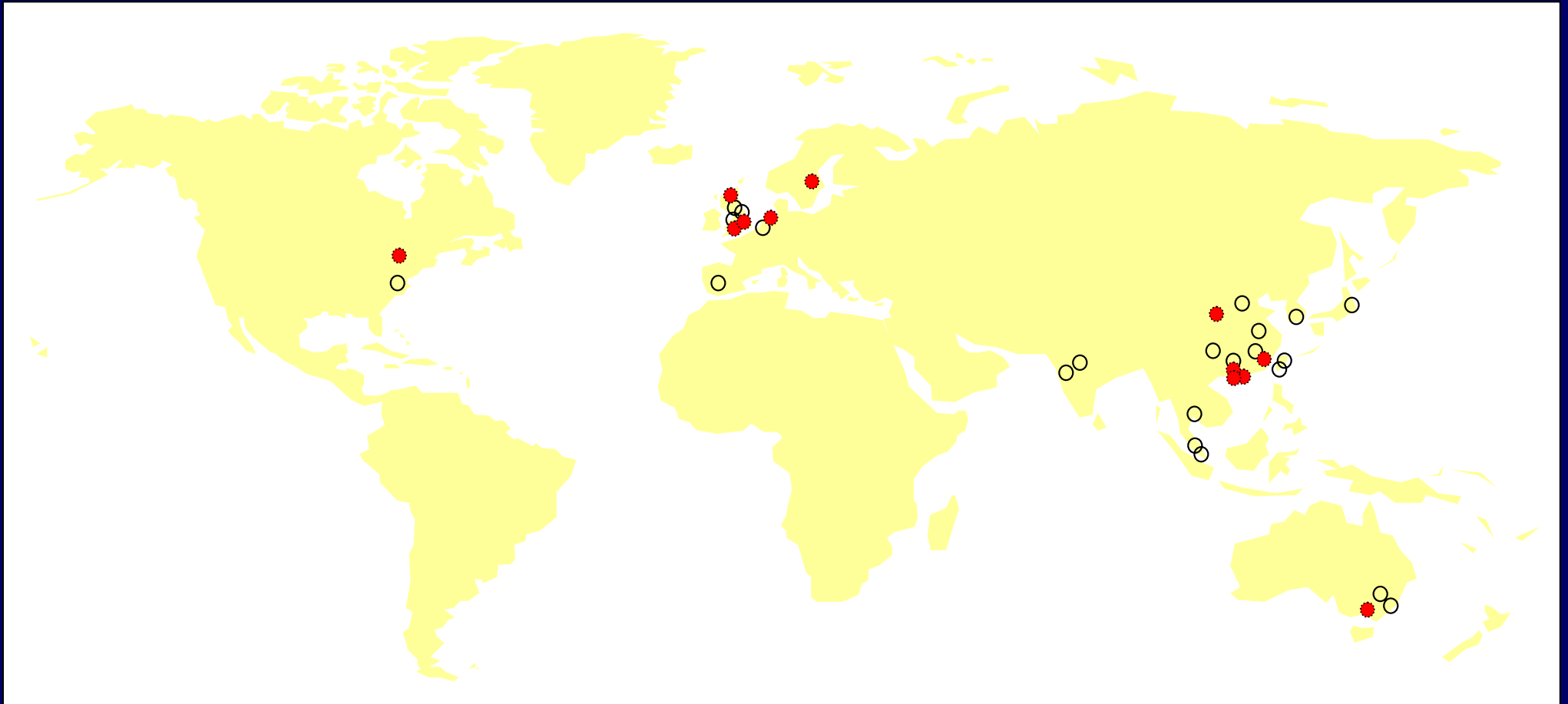


Competition



Business in the 21st Century

- Growth & New Business outside HK



Risk Based Safety Management System

- Define what is safe and unsafe by risk level
- Prioritize the effort/resources to be spent on “unsafe” item according to its risk level
- Higher the risk – more resource/effort should be spent and quicker should the risk be remove or reduced



Evolution of Safety Management

Safety Performance

Unspoken Rules

Account of past experience

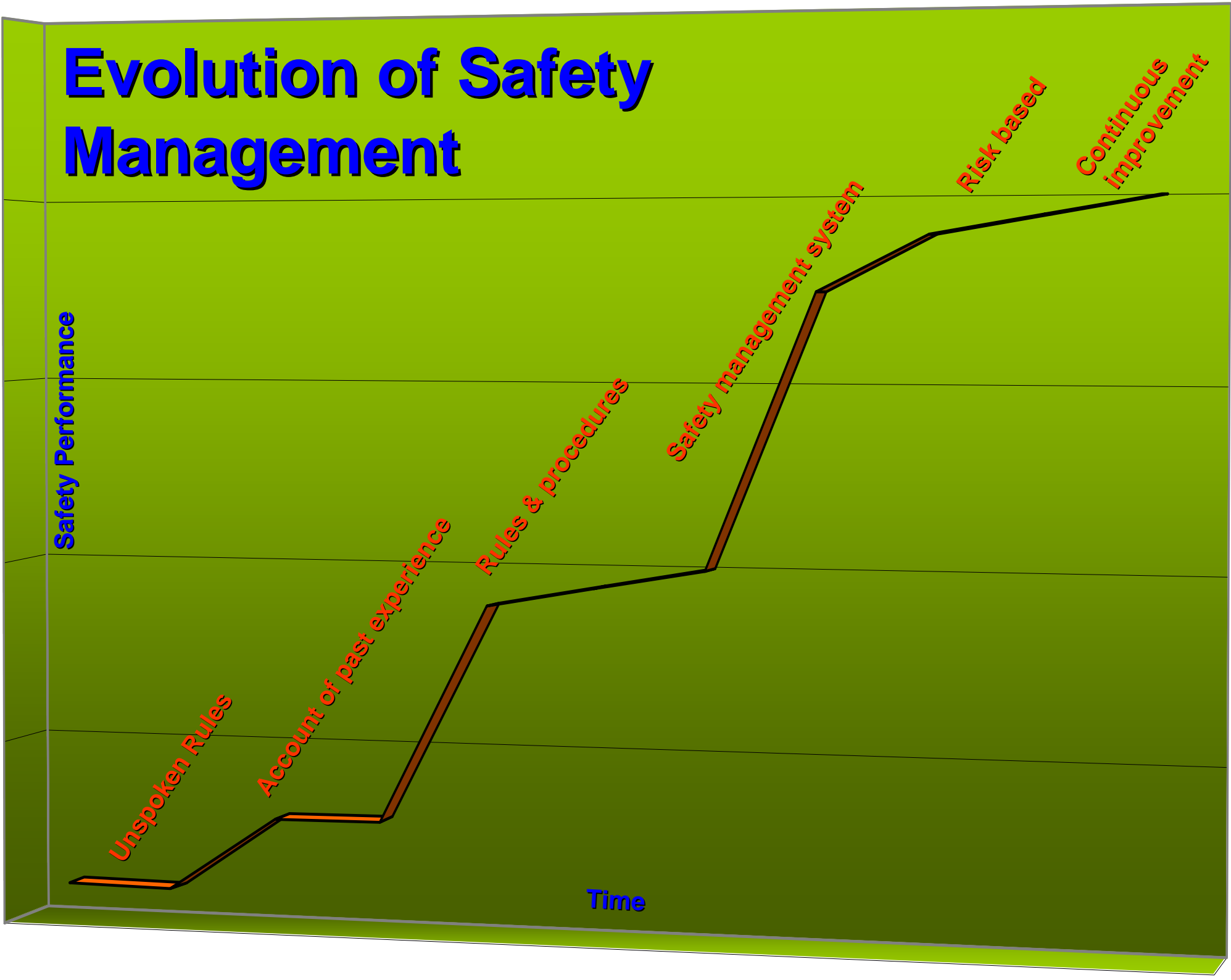
Rules & procedures

Safety management system

Risk based

Continuous improvement

Time



Benefits of Risk Based System

- Focus and prioritization on high risk items
- Ensure cost effectiveness in further safety improvement (by reducing risk)
- It can be built-on existing safety management system without abortive effort
- Progressive improvement possible by modular package and regular review of targets



Key Processes of Risk Management



Risk Quantification

Definition of “risk”

(According to the Advanced Learner’s Oxford Dictionary - 6th edition 2004)

- The possibility of something bad happening at some time in the future
- A situation that could be dangerous or have a bad result



Typical Risk Management Approach

Risk Assessment

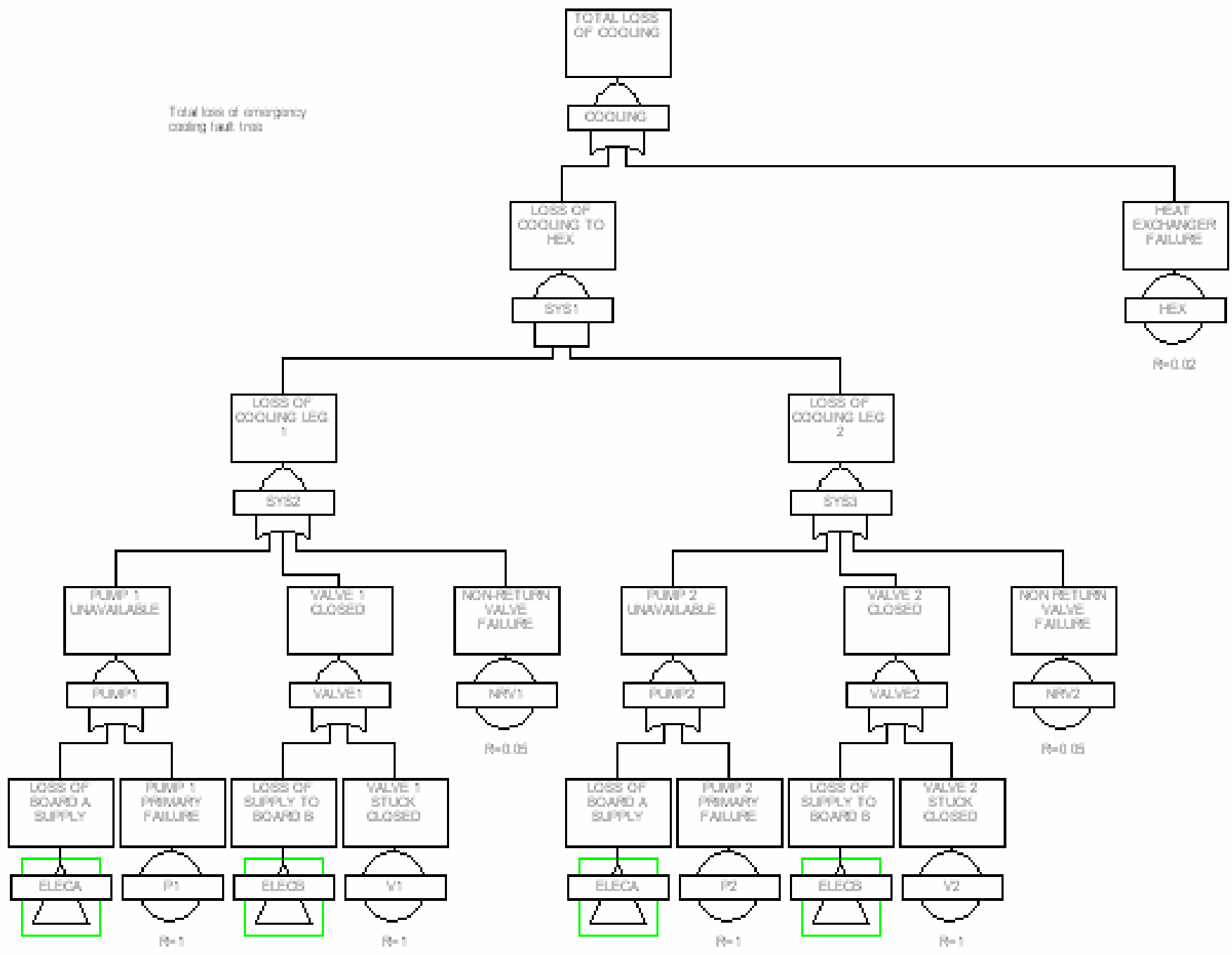
- Identify hazards
- Group hazards according to similar initiating events
- Fault tree analysis to determine initiating frequency
- Event tree analysis to determine severity of consequences and their likelihood
- Summation of potential injury and fatality – F/N Curve

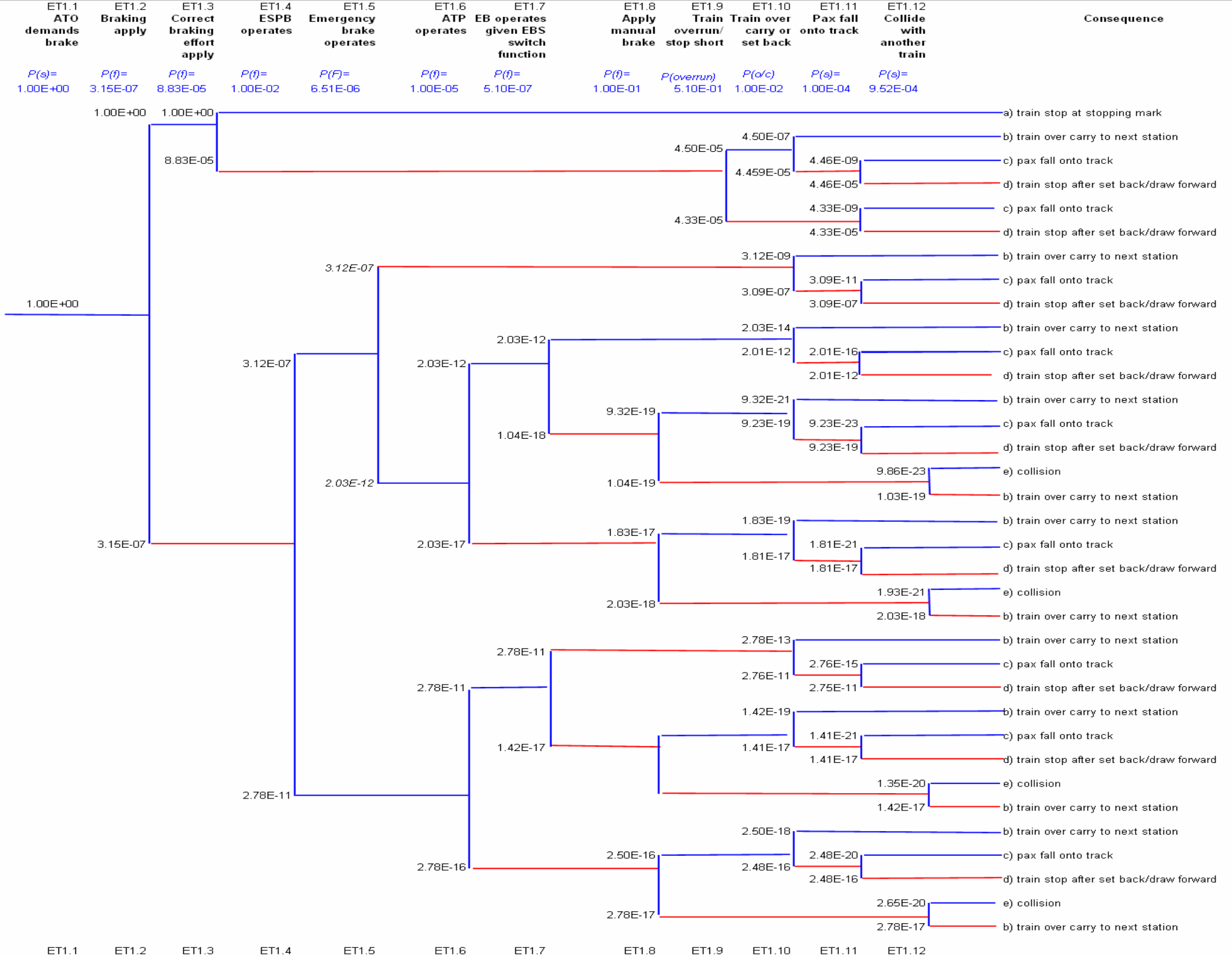
Risk Control

- Sensitivity and Importance Analysis to identify major risk contributor
- Development improvement actions
- Re-run risk model with improvement actions to give new results

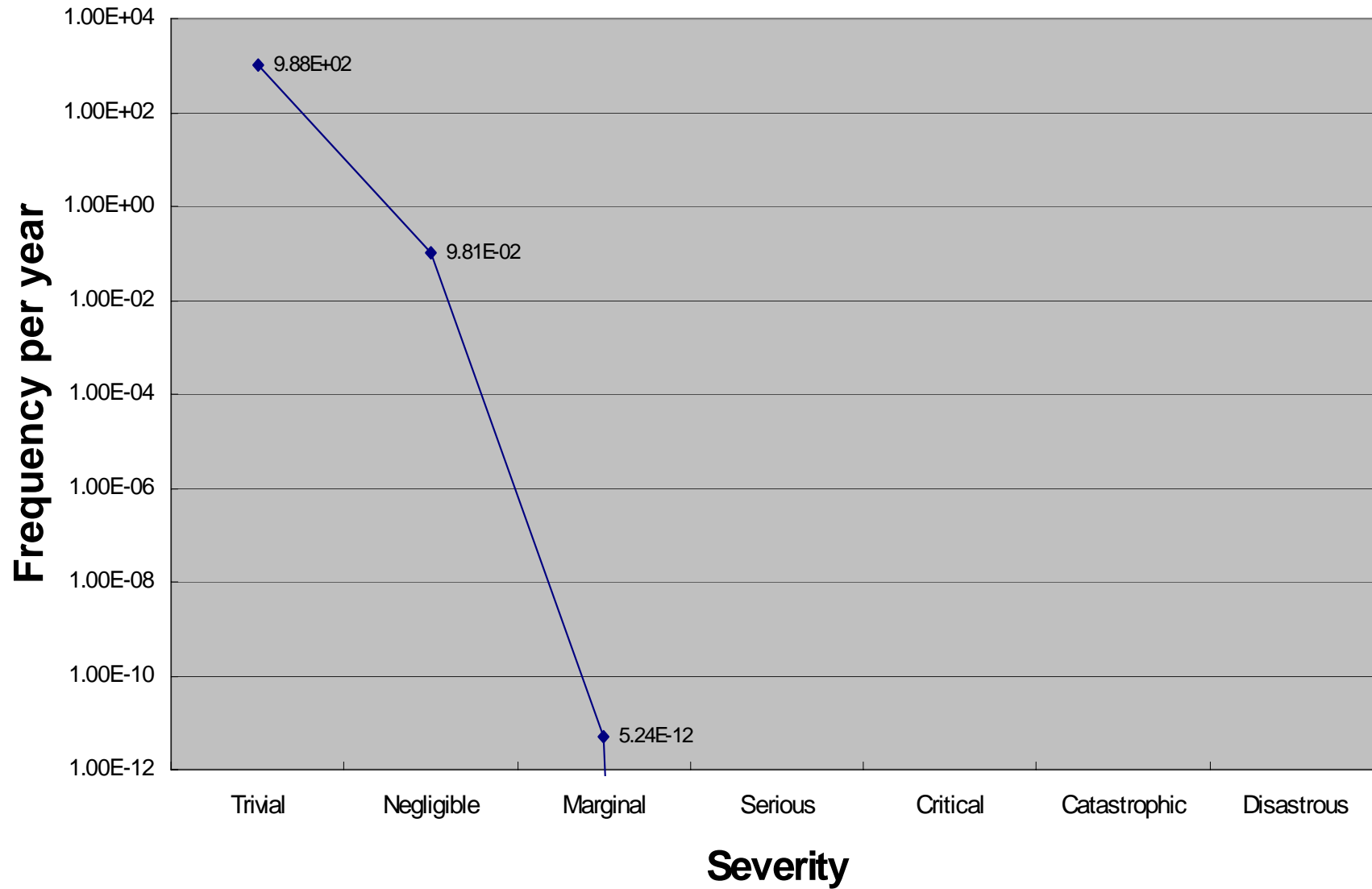


Total loss of emergency cooling fault tree





Overall Risk Profile



Downsides as a Risk Control Tool

- Large amount of effort on risk model construction, data gathering and analysis
- Dedicated specialist team
- Time consuming
- Only provides a snap shot of risk at the time
- Expensive to have a “live” risk model



Alternative Approach - Control Risk at Root Cause

- Identify hazards and control the risk at root causes
- Rank hazards according to a risk matrix
 - R1 – Unacceptable
 - R2 – Undesirable
 - R3 – Tolerable
 - R4 – Acceptable
- Control the risk of each hazard by reducing R1/R2 hazards to R3/R4
- Measure and monitor the number of hazards in each rank
- Measure the aggregated risk level of all hazards
- Can be monitored by function, equipment & facilities or by division, department & section.



Qualitative Risk Rating of Hazards

		Consequence			
		Minimal	Low	Medium	High
Likelihood	High	R3	R2	R1	R1
	Medium	R3	R3	R2	R1
	Low	R4	R3	R3	R2
	Minimal	R4	R4	R3	R3

R1 – Unacceptable, risk must be reduced save in exceptional circumstances.

R2 – Undesirable, risk must be reduced if it is reasonably practicable to do so.

R3 – Tolerable, risk is tolerable but should be further reduced if it is cost effective to do so.

R4 – Acceptable, risk is acceptable and no specific action is needed.



Cost per Statistical Life Saved (CpSLS)

- Cost of risk reduction is evaluated using the Cost per Statistical Life Saved (CpSLS)

$$\frac{\text{Cost}}{\text{Reduction in Fatality}} < \text{CpSLS}$$

- If the CpSLS is lower than a pre-determined figure, the cost is deemed not grossly disproportional to the risk.
- Otherwise, a more cost effective solution is needed.



HR - Update

- Hazard Register
- Committee Discussion Log Register
- C&R Works Proposal
- Report
- Code Maintenance
- C&R Project Hazard Log
- Safety Critical Item

Hazard ID:
Original Hazard ID:
Date: 09/11/2005 Level: 3

- MainInfo
- Safeguard
- Process&Status
- Project
- ProjectAudit

Hazard Description: *

	Current/Original	Residual
Frequency:	* <input type="text" value="H. Remote"/>	<input type="text" value="H. Remote"/>
Severity:	* <input type="text" value="3. Critical"/>	<input type="text" value="3. Critical"/>
Risk Index:	* <input type="text" value="R3"/> <input type="button" value="CDL-ADD"/> <input type="button" value="CDL-UPD"/>	<input type="text" value="R3"/>
RCPI:	<input type="text" value="0"/>	Committee Response: * <input type="text" value="Endorsed"/>

Potential Cause: *

Effect/Consequence: *

Lead Hazard Controller:
Work Activity:
Applicable To: *

- AWE
- DRL
- H&S
- LAR
- TKL
- URL

Susceptible Group: * Safety On Passenger Staff Contractor Public
 Service Disruption Environmental

System: *
Subsystem: *

Sys Operating Mode: * Date of Registration: *

A Holistic Risk Control System



Safety & Service Risk Management

Staff/Contractor Safety →

Passenger/Public Safety →

Service →

		CONSEQUENCE						
		7	6	5	4	3	2	1
		Trivial	Negligible	Marginal	Serious	Critical	Catastrophic	Disastrous
Staff/Contractor Safety	Fatality					<5	5 or more	
	Major Injury				<5	5 or more		
	Minor Injury			<5	5 or more			
			<5	5 or more				
Passenger/Public Safety	Fatality					<5	5-50	51-500
	Major Injury				<5	5-50	51-500	501 - 5000
	Minor Injury			<5	5-50	51-500	501 - 5000	>5000
Service	System Disruption			<20 min	1 hour	1 day	1 week	1 month
	Line Disruption		20-60min	few hours	1 day	1 week	1 month	few months
	Station Disruption	<20min	few hours	1 day	1 week	1 month	few months	1 year
FREQUENCY	A	≥ 100 /year	100	1,000	10,000	100,000	1,000,000	10,000,000
	B	≥ 10 - <100 /year	10	100	1,000	10,000	100,000	1,000,000
	C	≥ 1 - <10 /year	1	10	100	1,000	10,000	100,000
	D	≥ 0.1 - <1 /year		1	10	100	1,000	10,000
	E	≥ 1E-2 - <1E-1 /year			1	10	100	1,000
	F	≥ 1E-3 - <1E-2 /year				1	10	100
	G	≥ 1E-4 - <1E-3 /year					1	10
	H	≥ 1E-5 - <1E-4 /year						1
	I	≥ 1E-6 - <1E-5 /year						
	J	< 1E-6 /year						

Legends: R1 R2 R3 R4

R1
R2
R3
R4

Risk must be reduced save in exceptional circumstances

Risk must be reduced if it is reasonable practicable to do so

Risk is tolerable but should be further reduced if it is cost effective to do so

Risk is acceptable



Security Risk Management



Service Disruption

Corporate Assets

Criminal Imprisonment

Business Impact

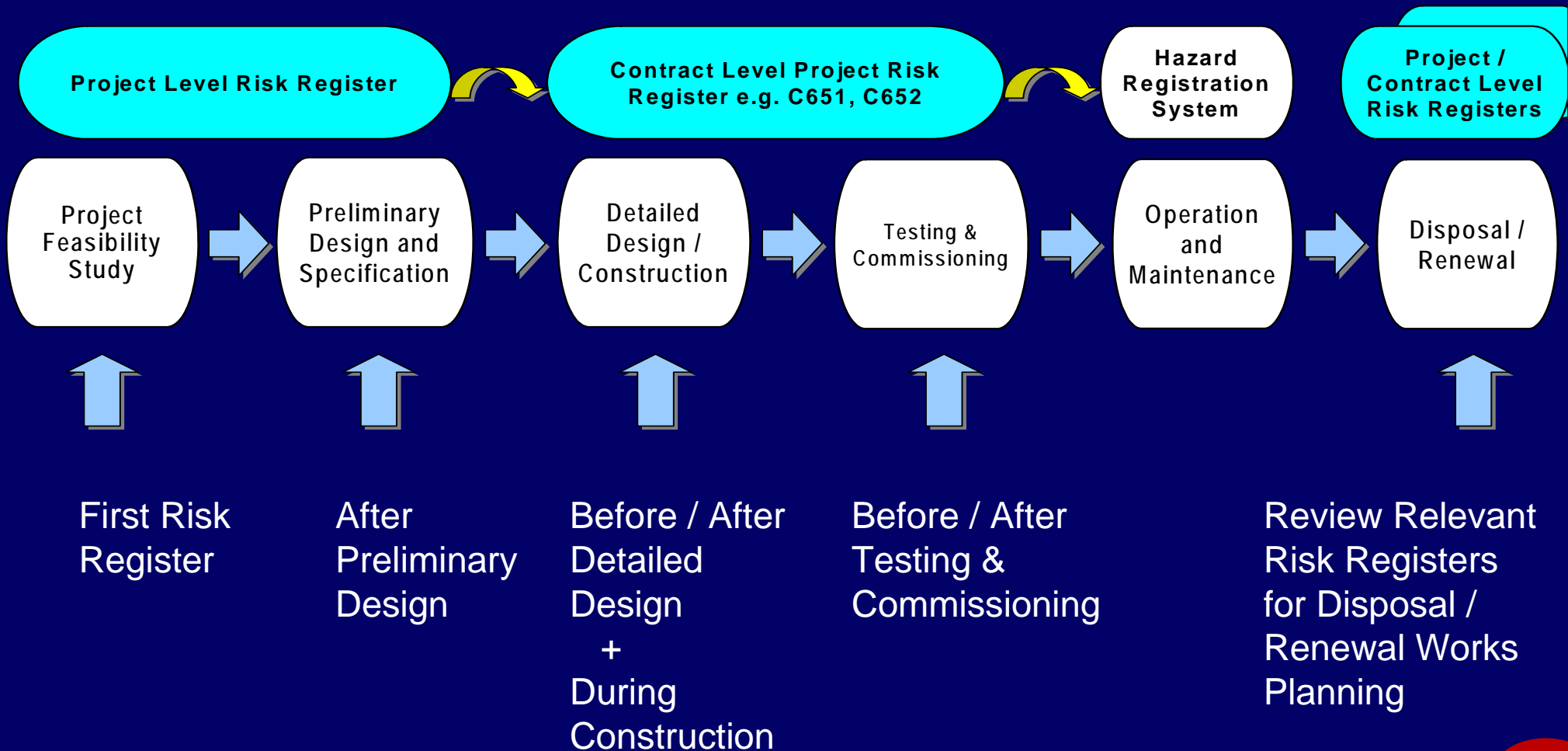
- SeR1 – Risk must be reduced except in exceptional circumstances
- SeR2 – Risk must be reduced if it is reasonable or practicable to do so
- SeR3 – Risk is tolerable but should be further reduced if it is cost effective to do so
- SeR4 – Risk is acceptable

		Consequences			
		Relatively unimportant	Moderately serious	Very serious	Extreme
Service disruption	System	--	--	--	Any
	Line	--	--	20 – 60 mins	Hours
	Station	--	20 – 60 mins	Hours	1 day
Loss of Corporation assets		<\$100,000	\$100,000 – 1,000,000	\$1,000,000 – 10,000,000	\$10,000,000+
Normal sentence imposed to offenders committing crimes against passenger / staff / third party / Corporation		≤ 5 years imprisonment	> 5 to ≤ 10 years imprisonment	> 10 to ≤ 20 years imprisonment	> 20 years imprisonment
Non-financial impact		Minor degradation of service, impact limited to a single area of the business, management intervention required	Significant degradation of service, impact to multiple areas of business, can be managed with significant management intervention	Major degradation of service, impact to widespread areas of the business, would not threaten viability but would require significant mobilisation of resources and significant management intervention	Threatens long-term viability of the business
		Likelihood			
Very high – every week (>50/yr)		SeR2	SeR2	SeR1	SeR1
High – every month (11 - 50/yr)		SeR3	SeR2	SeR2	SeR1
Medium – every year (1 - 10/yr)		SeR4	SeR3	SeR2	SeR2
Low – less than yearly (<1/yr)		SeR4	SeR4	SeR3	SeR2



Project Risk Management

- Project Risk Register Preparation / Updating during project life cycle



Project Risk Management

■ Project Risk Categories

- Health, safety & environment
- Business disruption
- Business viability
- Project complexity
- Cost Overrun
- Programme Delay
- Political / Public / Media Pressure
- Technical Difficulty
- Meeting Customer Expectation
- Recovery / Crisis Management



Project Risk Management

■ Project Risk Matrix

		Consequence			
		Minimal	Low	Medium	High
Likelihood	High	P3	P2	P1	P1
	Medium	P3	P3	P2	P1
	Low	P4	P3	P3	P2
	Minimal	P4	P4	P3	P3

P1 – Unacceptable

P2 – Undesirable and requires contingency measures and continuous monitoring

P3 – Tolerable

P4 – Acceptable



Project Risk Management

■ Project Risk Register

Risk ref no.	Timeline (Closed/ current/ future)	Description of risk / event	Cause	Consequence	Relevant risk categories (Exhibit 7.3)	Likelihood of event happening	Consequence / Impact of event	Initial risk rating	Risk mitigation method	Action Owner	Residual Likelihood	Residual Consequence	Residual risk rating	Status of risk mitigation completion
01	Current	Operating railway tunnel flotation	Changes in water table, removal of top soil above tunnel, flooding of excavation work site	Major operating railway service disruption	Business Disruption, Recovery / Crisis Management	High	High	P1	Install system to monitor tunnel movement	SConE-Civil	Low	High	P2	Monitoring system installed since 1 Jul 03 and will continue until 30 Sep 03 (Note: Risk is registered in Ops Division HRS as R3 service risk)
02	Future	Delay in essential material delivery	Special shipment from overseas	Programme delay	Programme Delay	Medium	High	P2	Early batch order	SConE-Civil	Low	High	P3	Batch order issued on 12 Aug 03



Environmental Risk Management

- Environmental areas of concern
 - Noise
 - Water
 - Air
 - Land
 - Waste
 - Resources
 - Vibration
 - Habitat
 - Landscape & Visual



Environmental Risk Management

■ Environmental Risk Severity Definition

Severity		4	3	2	1
Area of Impact		Negligible	Marginal	Serious	Critical
1	Noise ⁽¹⁾	<ul style="list-style-type: none"> Operational noise generated but will not affect public, OR Operational noise generated during 0700-2300Hrs that will affect public but will not cause complaint, OR Construction noise generated outside restricted hours⁽²⁾ but will not seriously affect public 	<ul style="list-style-type: none"> Operational noise generated during 0700-2300Hrs that will affect public and will likely cause complaint, OR Operational noise generated during 2300-0700Hrs that will affect public but will unlikely cause complaint, OR Construction noise generated outside restricted hours⁽²⁾ that will affect public but will unlikely cause complaint 	<ul style="list-style-type: none"> Operational noise generated during 2300-0700Hrs that will affect public and most likely will cause complaint, OR Construction noise generated outside restricted hours⁽²⁾ that will affect public and most likely will cause complaint 	<ul style="list-style-type: none"> Operational noise generated that will affect public and possibly lead to legal action OR Construction noise generated during restricted hours⁽²⁾
•2	•Water	<ul style="list-style-type: none"> Wastewater⁽³⁾ generated but the amount is insignificant and is most likely uncontaminated 	-	-	<ul style="list-style-type: none"> Wastewater⁽³⁾ generated and the discharge may be contaminated
3	Air	<ul style="list-style-type: none"> Minor air pollutant⁽⁴⁾ is generated but will not affect public and passenger 	<ul style="list-style-type: none"> Air pollutant⁽⁴⁾ is generated that will affect passenger but not public, OR Air pollutant is generated that may affect public but will unlikely cause complaints or concerns 	<ul style="list-style-type: none"> Air pollutant⁽⁴⁾ is generated that will affect public, and may lead to complaints or concerns 	<ul style="list-style-type: none"> Air pollutant⁽⁴⁾ is generated that will affect public and/or passenger, and may lead to legal action
4	Land	<ul style="list-style-type: none"> Insignificant land contamination 	<ul style="list-style-type: none"> Small or medium scale land contamination 	<ul style="list-style-type: none"> Large scale land contamination but recoverable 	<ul style="list-style-type: none"> Large scale land contamination but not recoverable
5	Waste ⁽⁵⁾	<ul style="list-style-type: none"> Generate small amount of trade waste 	<ul style="list-style-type: none"> Generate medium amount of trade waste 	<ul style="list-style-type: none"> Generate large amount of trade waste 	<ul style="list-style-type: none"> Generate huge amount of trade waste Generate chemical waste
•6	•Resources ⁽⁶⁾	<ul style="list-style-type: none"> Consume small amount of resources 	<ul style="list-style-type: none"> Consume medium amount of resources 	<ul style="list-style-type: none"> Consume large amount of resources 	<ul style="list-style-type: none"> Consume huge amount of resources
•7	•Vibration	<ul style="list-style-type: none"> Vibration outside restricted hours⁽²⁾ which will not seriously affect public 	<ul style="list-style-type: none"> Vibration outside restricted hours⁽²⁾ which will unlikely cause complaints 	<ul style="list-style-type: none"> Vibration outside restricted hours⁽²⁾ which may cause complaints 	<ul style="list-style-type: none"> Vibration in restricted hours⁽²⁾
•8	•Habitat	<ul style="list-style-type: none"> Degradation of small area of habitat of low ecological interest 	<ul style="list-style-type: none"> Degradation of small to medium area of habitat of low ecological interest 	<ul style="list-style-type: none"> Degradation of medium area of habitat of low ecological interest 	<ul style="list-style-type: none"> Degradation of any habitat of medium or high ecological interest, OR Degradation of large area of low ecological interest
•9	•Landscape and Visual	<ul style="list-style-type: none"> Small scale landscape and visual impacts 	<ul style="list-style-type: none"> Medium scale landscape and visual impacts 	<ul style="list-style-type: none"> Large scale landscape and visual impacts 	<ul style="list-style-type: none"> Huge landscape and visual impacts

Environmental Risk Management

- Environmental Risk Matrix

		Severity (Scale)		Frequency (No. per year)					
				4	3	2	1		
				Negligible	Marginal	Serious	Critical		
N / S		A / E							
A 1	Few times per week or more	≥ 100	A 2	Few times per month or more	≥ 10	ER3	ER2	ER1	ER1
B 1	Few times per month	$\geq 10 < 100$	B 2	Few times per year	$\geq 1 < 10$	ER4	ER3	ER2	ER1
C 1	Few times per year	$\geq 1 < 10$	C 2	Few times per 10 years	$\geq 10^{-1} < 1$	ER4	ER3	ER2	ER2
D 1	Few times per 10 years	$\geq 10^{-1} < 1$	D 2	Once since operation	$\geq 10^{-2} < 10^{-1}$	ER4	ER3	ER3	ER2
E 1	Once since operation	$\geq 10^{-2} < 10^{-1}$	E 2	Unlikely to occur	$\geq 10^{-3} < 10^{-2}$	ER4	ER4	ER3	ER2
F 1	Unlikely to occur	$< 10^{-2}$	F 2	Very unlikely to occur	$< 10^{-3}$	ER4	ER4	ER4	ER3



Outsourcing Risk Management

- Outsourcing Risk Categories
 - Health, safety & environment
 - Business disruption
 - Business viability
 - Project complexity
 - Cost Overrun
 - Programme Delay
 - Political / Public / Media Pressure
 - Technical / Construction Difficulty
 - Meeting Customer Expectation
 - Recovery / Crisis Management



Outsourcing Risk Management

		<i>SEVERITY</i>		
		L	M	H
	<i>Health, Safety and Environment</i>	Nil	?Result in a R3/R4 hazard ¹ ?Affect the operating safety in general ?Affect the operation of Safety Critical Item ²	?Result in a R1/R2 hazard ¹ ?Breach of statutory requirements e.g. O&SH regulations ?Affect the operation of Safety Critical System
	<i>Business Disruption</i>	Service Disruption in Station: 20~60 min Line: ≤ 20 min	Service Disruption in Station: few hours Line: ≤ 20~60 min	Service Disruption in Station: > 1 day Line: few hours
	<i>Project / Business Viability¹</i>	Nil effect, impact limited to a single area of business	Some losses, impact to multiple areas of business	Significant losses, impact to widespread areas of the business
	<i>Project Complexity</i>	Nil / Manageable	Some challenges	Significant challenges
	<i>Cost Overrun</i>	Minor variation	Some variation	Significant variation
	<i>Programme Delay</i>	Nil / Manageable	Some delay	Significant delay
	<i>Political / Public / Media Pressure</i>	Nil / Manageable	Some	Frequent
	<i>Technical / Construction Difficulty</i>	Easy	Difficult	Very difficult
	<i>Meeting Customer Expectation</i>	Yes	Partially	No
	<i>Recovery / Crisis Management</i>	Nil / Manageable	Some challenges	Significant challenge
LIKELIHOOD				
Likely	H	M2	M1	M1
Unlikely	M	M3	M2	M1
Very Unlikely	L	M4	M3	M2



Outsourcing Risk Management

■ Outsourcing Risk Register

SE8-C Risk Register for Outsourced Maintenance / Service Contracts (SAMPLE TEMPLATE)

CONFIDENTIAL

No.	Risk Area	Possible Causes	Effect/Consequences	Expected Scenarios & Impact on Operation (Optional)	Likelihood	Severity (Type)	Original Risk	Safeguards	Likelihood	Severity (Type)	Residual Risk	Action Owner	Action Status
1. Health, Safety & Environment													
	Establishment of Safety Management System	<ul style="list-style-type: none"> - Unclear hazard ownership and transfer process - Hazard identification, evaluation, control and review are not properly carried out 	<ol style="list-style-type: none"> 1) Hazards are not properly identified and controlled 2) Increase operational risk 3) Potential higher cost of remedies 	<ol style="list-style-type: none"> 1) Increase the operational risks to the corporation 2) Cost of risk control is much higher 	M	M	M2	<ol style="list-style-type: none"> 1) Specify in the outsourcing contract that Contractor should follow the Corporate procedures on safety management <ul style="list-style-type: none"> - Implement a comprehensive hazard identification and control process - Implement safeguards - Continuously monitor the effectiveness of risk mitigation measures. 2) MTR to carry out regular audits on contractor's process on hazard identification, assessment, control and monitoring. 	L	L	M4	Contractor?	Outstanding or Closed?
2. Business Disruption													



Enterprise Risk Management

- **Primary functions of ERM**
 - **To provide a clear view of principal enterprise risks**
 - **To ensure effective enterprise-wide management of risks**
 - **To develop a sustainable and auditable risk management process**
 - **To ensure consistent approach to risk management in all areas**
 - **To develop a systematic and enterprise-wide risk management framework**



Thank you

