



**London Power Forum 2013**

**Coal Generators GENSIP Programme**

**13th November 2013**

**Nigel Carter**

Chairman – Rotating Plant Working Group

# Agenda

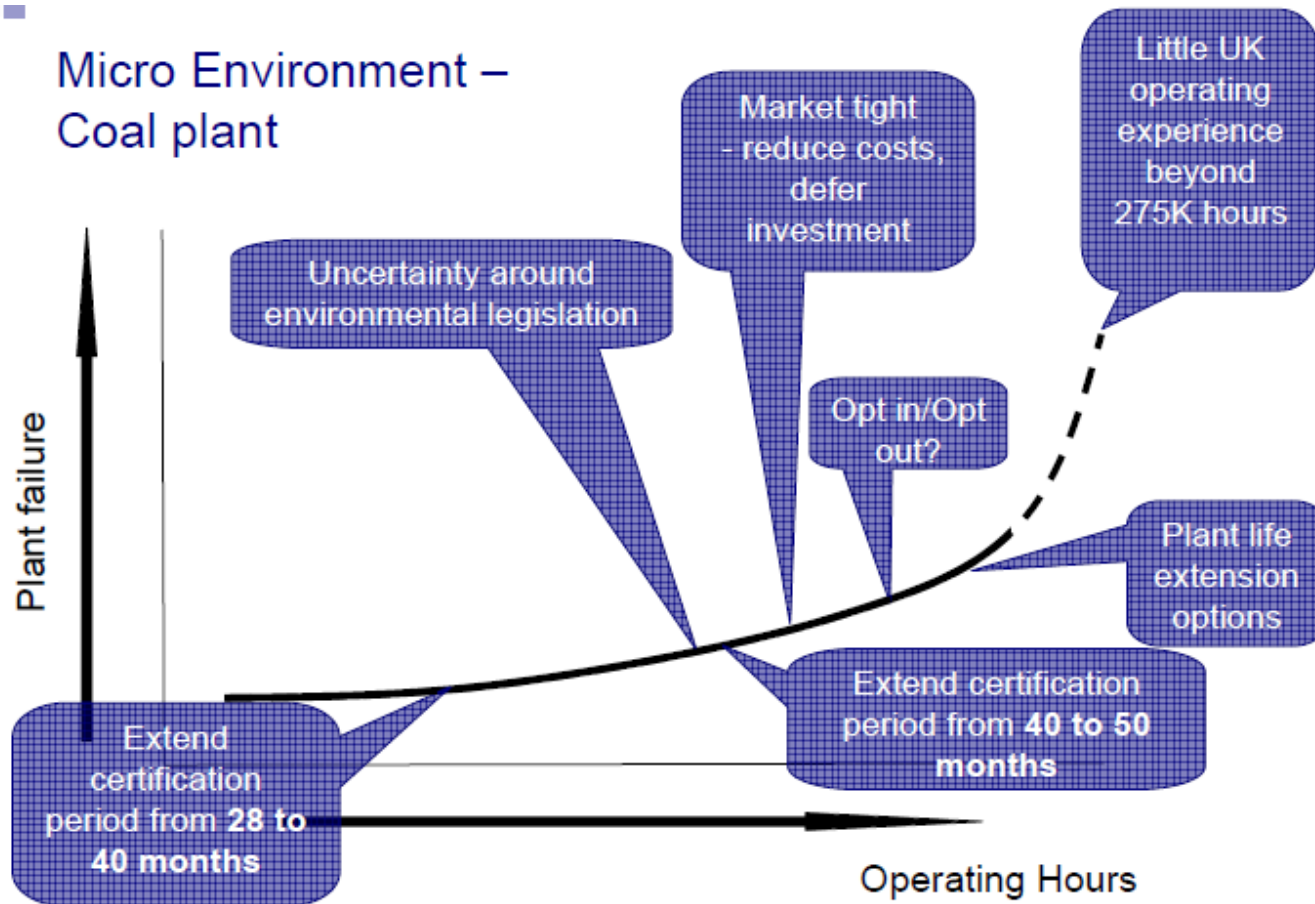
- **GENSIP Background**
- GENSIP Raison d'être
- GENSIP Risk Management Cycle & Process
- GENSIP 2011/12 Work Programme
- GENSIP Publications
- GENSIP Safety Alerts
- GENSIP The future

# Background

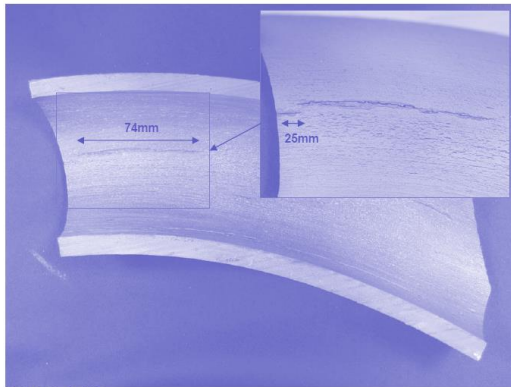
About 55 large coal fired power generating units in Great Britain,

- Typical size 500 MW
  - Mostly built 1966 – 1986
  - Base load operation for about 25 years, then flexible operation for 15 years
  - Typical running hours now 200,000 – 275,000 plus hours
  - Typical starts 2,000 – 3,000
- 
- Emerging integrity issues with major personnel safety implications

# Micro Environment - Coal plant



# Incidents of national concern



A-side Bend 1B2.

Figure 2: Appearance and Length of Cracking on Internal Surface

## BBC News, 21st January 2007:

### Belt collapse shuts power station

Power station has been shut down after the main conveyor belt collapsed. It fell onto a building below



## BBC News, 22<sup>nd</sup> August 2006:

### Accident shuts down power station

A major power station remains closed after two people were scalded in an accident. (The problem was caused by pipe work at the bottom of one of the boilers)



Figure 3: Micrograph showing a crack in a metal surface. Cracking from 700°C

Technical Report No. 1, October 2005  
Other info. For use only by members of GENSIP and AEP



# Near miss incidents of industry concern

- Increasing number of plant integrity failures
- Different failure modes emerging (e.g. flow assisted corrosion)
- Failures in previously low risk locations

# Industry response - GENSIP

- Generators' Safety and Integrity Programme
- All 8 coal generating companies operating in Great Britain
- Non-competitive common issues affecting personnel safety
- Jointly funded work programme to enable good practice guidance to be produced for key risks
- Interface with UK Health and Safety Executive

# Coal Generators Forum membership



An **RWE** company





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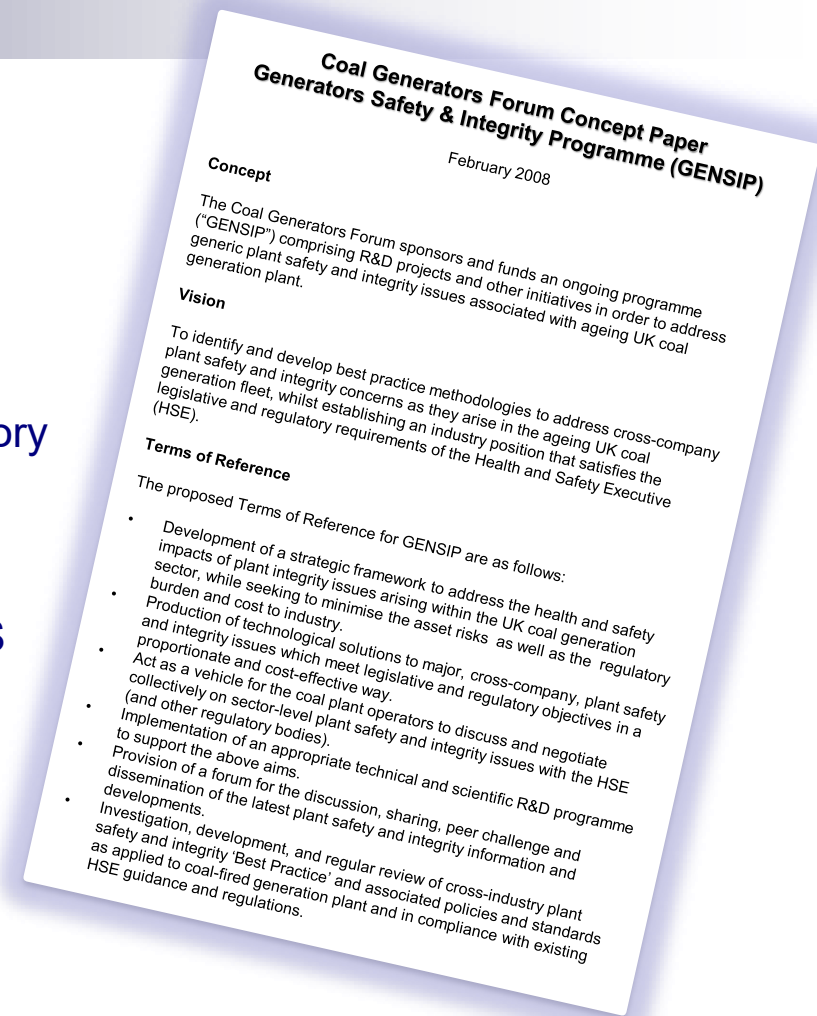
# GENSIP Raison d'être

## Vision

... develop best practice methodologies ... cross-company plant safety and integrity ... ageing UK coal generation fleet ... satisfies the legislative and regulatory requirements of HSE.

## Terms of Reference

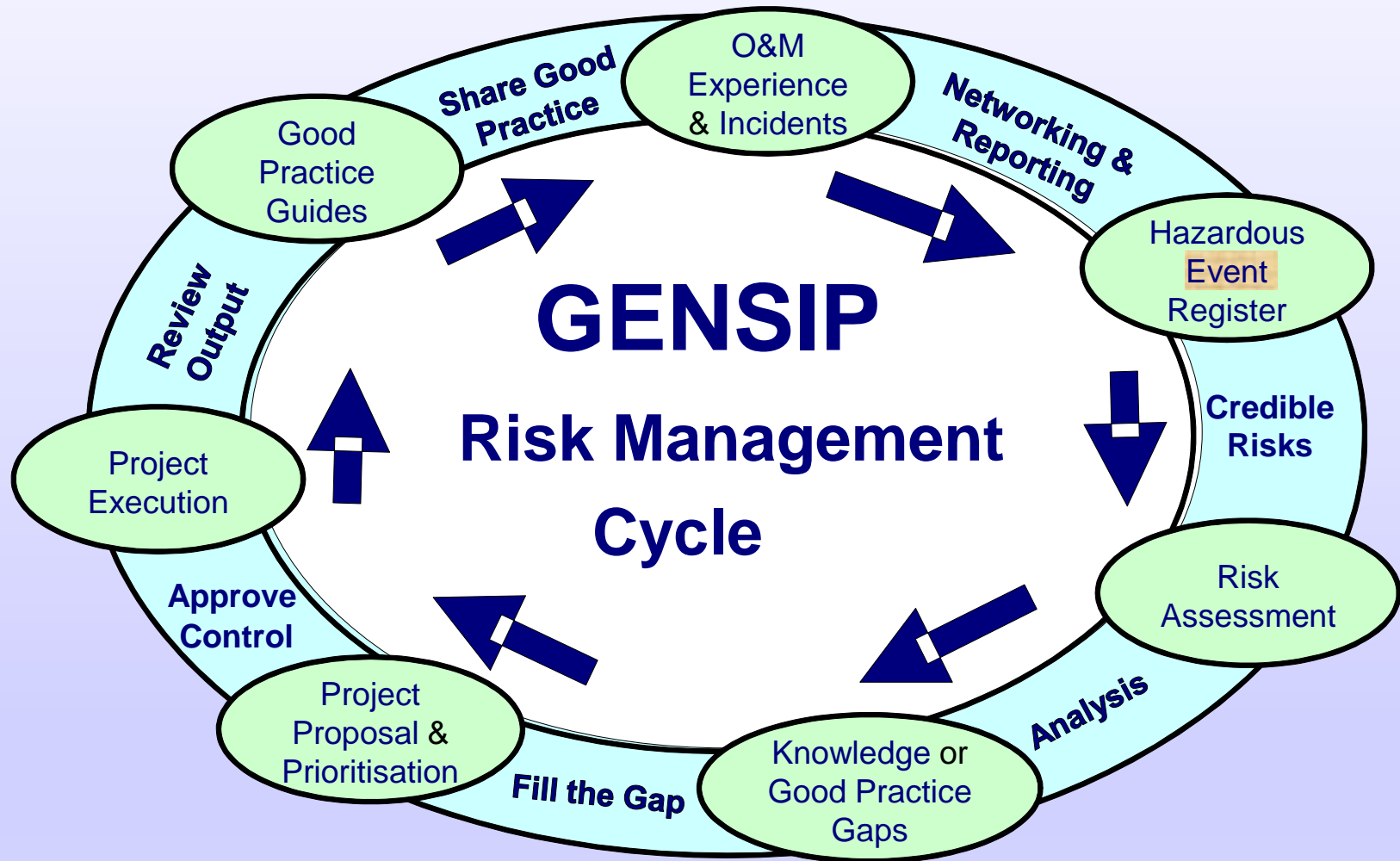
- Create a strategic framework to address the H&S impacts of plant integrity issues
- Technological solutions to major, cross-company, plant safety and integrity issues supported by technical and scientific R&D programme.
- Development of 'Good Practice' and associated policies and standards.
- Discussion, sharing, peer challenge through specialist working groups.
- Work through the AEP on plant safety and integrity issues of concern to the HSE.



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# GENSIP Process



# Process Overview

Hazardous  
Events  
Register

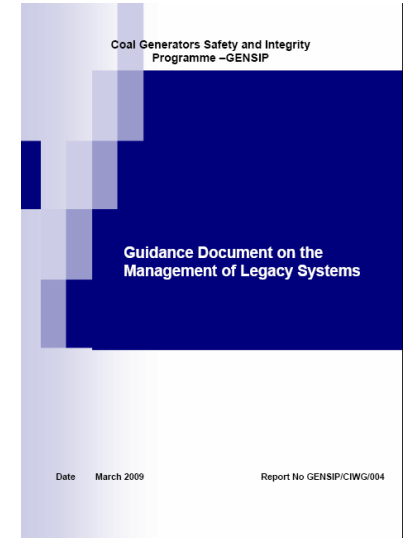
Risk  
Assessment  
Forms

Reports

Good Practice Guides

Reference	Reference	Frequency	Consequence	Probability	Prevalence	Hazard
1	PS01	3	10	01	01	Failure of HP feed system pipework
2	PS1	3	10	01	01	Major Loss of Containment from a High Temperature Pipework
3	PS5	3	10	01	01	Pipe rupture and catastrophic weld failure from a major low temperature steam line
4	PS2	4	1	01	01	Explosion External Boiler Tube Rupture
5	SH05	3	1	1	01	Switchover and flash explosion while locally operated
6	CS003	3	1	1	01	Walkways and Drains
7	PS3	3	3	01	003	Rupture of boiler impingement tubes circulating and saturated steam pipework, fabricated in C steel materials with an internal diameter > 50mm
8	PS10	2	10	01	001	Catastrophic failure of boiler feedwater pipework
9	PS6	2	10	01	001	De-Aerator Vessel Rupture
10	PS4	4	1	001	001	Rupture of boiler drains pipework systems including blowdown systems
11	PS25	4	1	001	001	Auxiliary Steam and minor systems
12	PS11, PS12	4	1	001	001	Combustion generated over pressurisation of enclosures and pipework
13	SH06	2	1	1	001	Electrocution due to contact with live conductors
14	CS011	5	1	001	001	Falling loadings and objects from buildings
15	CS012	2	1	1	001	Integrity of buildings fabric to personnel access
16	CS017	5	1	1	001	

Ref	Mechanical Pressure Parts	Date	
MPP024	Revision	29/11/2008	
Area	HP feed system pipework	Rev 2	
Component / System	HP Pipework from MBEP to Economiser Inlet Check Valves		
<b>Description of HAZARD</b>			
Hazard (ex 24.30 in HER)			
pressure steam/water leak from a system at typically 180Bar and 360°C, resulting in loss of containment of the HP feed system and some LP systems including D/A but not tier contents (provided economiser check valves are fitted), probable pipe whip and lary damage. Lash steam volumes are large and could effect substantial portions of bine and boiler house. Large quantity of scalding water will also be released.			
<b>Description of Event</b>			
leak of a large high pressure feed pipe either as result of the catastrophic failure of the full loss of containment associated with a weld failure. This event excludes the of smaller drains type systems < 4" or boiler systems covered elsewhere.			
<b>Description of Cause (Know &amp; Potential failure mechanisms)</b>			
rupture due to corrosion fatigue initiated axially on bends.			
Poor bend ovality increases risk of initiation and crack growth			
Assisted Corrosion (FAC)			
Flow turbulence, Feed water chemistry, low alloy steel & operating temperatures.			
axial fatigue/ Thermal corrosion fatigue			
Related to top to bottom temperature differential, through wall temperature differentials			
Initiation at pipe butt welds and changes in section.			
in at manufacturing defects			
Initiation on axial seam welded pipes, pipe laps, score marks.)			
where figures for the following are not available use best estimate based on experience			
No. of Deaths per Event	No. of Major Injuries per Event	Frequency (Unit Events Per year)	Predicted Typical future UK Unit Event Frequency if Unaddressed
Worst (note 2) 10	Most Likely (note 3) 3	Historical Worst (note 1) 1	Worst (note 4) 0.0033
Most Likely (note 3) 3	Worst (note 2) 10	Most Likely (note 3) 3	Most Likely (note 3) 0.0033
Historical Worst (note 1) 1	Most Likely (note 3) 3	Worst (note 4) 0.0033	5 Years (note 5) 1
Worst (note 2) 10	Most Likely (note 3) 3	Most Likely (note 3) 0.0033	10 Years (Note5) 2



unknown or poorly managed hazards



known hazards adequately managed

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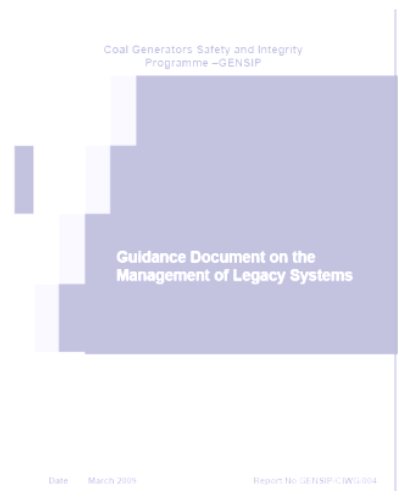
Ranking	Reference Frequency	Consequence	Probability	Product	Haz
1	01	0	01	01	Blad-Flashes/Explos
2	02	0	01	01	Igited/Overheating/Trip/Explos
3	03	0	01	01	Re-accidents/Explosion/Change in speed/Explos
4	04	1	01	01	Electrical Fire/Trip/Exp
5	05	0	1	01	Slip/trip/fall/Injury/Death
6	06	0	1	01	Slip/trip/fall
7	07	0	3	01	Blade failure/Explosion/Change in speed/Explos
8	08	0	01	01	Change in speed/Explos
9	09	0	01	01	Explosion/Fire
10	10	4	1	01	Blade failure/Explosion/Change in speed/Explos
11	11	4	1	01	Asphyxiant system
12	12	4	1	01	Cracking/Explosion/Change in speed/Explos
13	13	1	1	01	Electrical fire/Explos
14	14	0	1	01	Slip/trip/fall/Injury/Death
15	15	1	1	01	High voltage/Explos
16	16	0	1	01	Slip/trip/fall/Injury/Death

Risk  
Assessment  
Forms

Co Group	Mechanical/Pressure Parts	Date
Ref	MPP024	28/11/2004
Rev	HP feed system phasor	Revision
Part 1 System	HP Power/Flow MPP	Revision

Reports

Good Practice Guides



**ABB Engineering Services completed an independent review of the GENSIP Risk Management Process and confirmed that the process is fit for purpose.**

unknown or poorly managed hazards

GENSIP

known hazards adequately managed

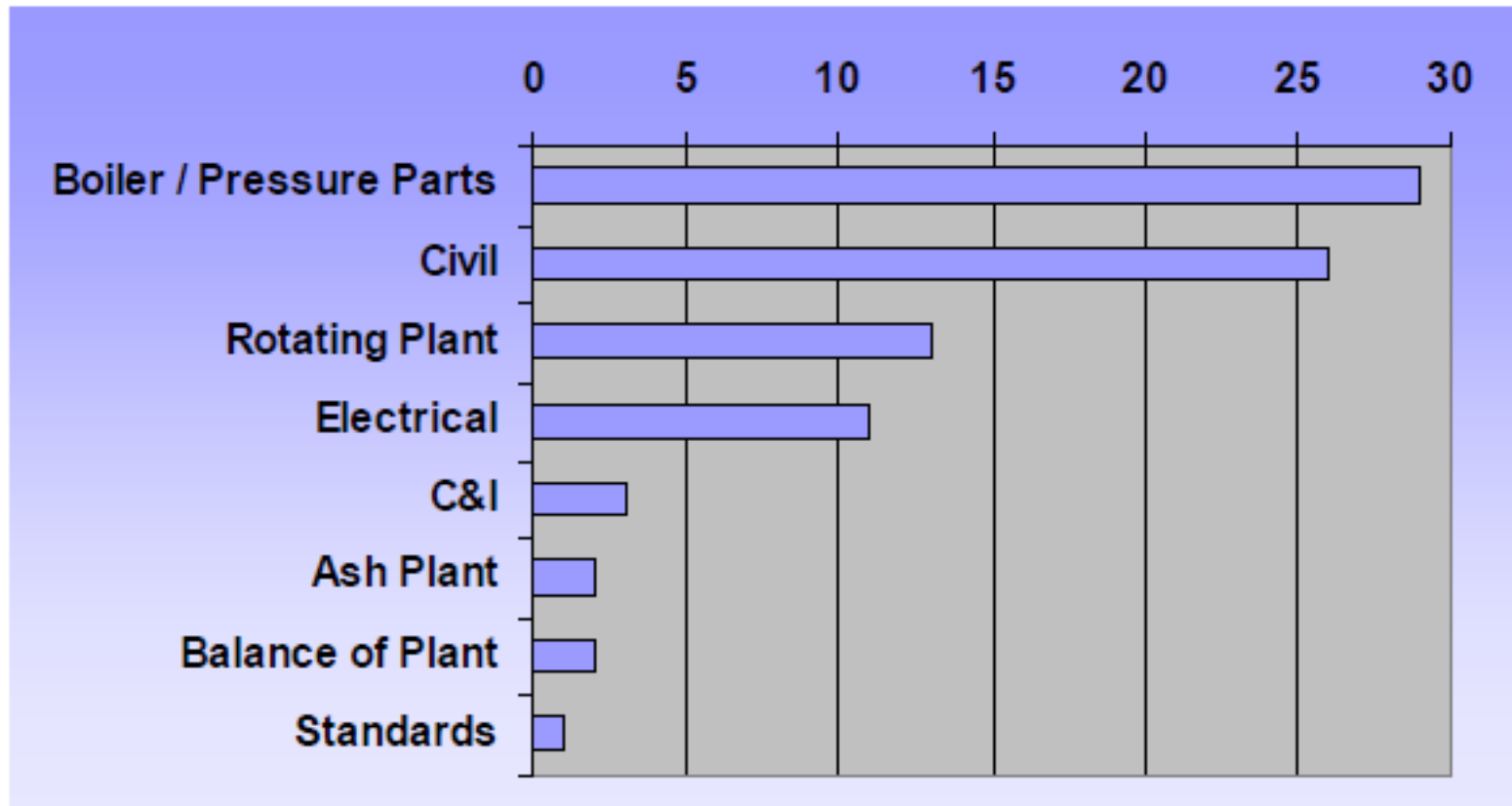
# Hazardous Events Register (HER)

**Objective – Identify credible potential / actual events which could lead to fatalities on GENSIP sites**

- HER forms the heart of GENSIP process
- Sectionalised HER circulated to Working Groups (WG)
- WGs reviewed, refined and endorsed HER sections
- Comprehensive and Approved Hazardous Events Register produced

# Hazardous Events Register

- 89 generic GENSIP fatality hazard events
  - Ageing coal units 500 / 660 MW





# Risk Assessment & Project Development

- Each Hazardous Event risk assessed
  - Provides detailed description / analysis of the risks for each event in Hazardous Events Register
- Risk Assessment provides basis for ranking to prioritise projects
- WG project proposals directly linked to one or more Hazardous Events from Register
- Project Proposals submitted for GENSIP Management Board approval
- CGF review and fund annual project programme (end March)
- Outputs - good practice guides including GENSIP agreed ALARP proposal for 'Tolerable' risks

# Hazardous Event Ranking

- Critical for prioritising projects, allocating resources and budgets
- Hazards scored by;
  - Event frequency (using historical data; forward judgement)
  - Consequence - potential number of fatalities
    - Includes probability of event impacting people
- Hazards ranked following risk assessment

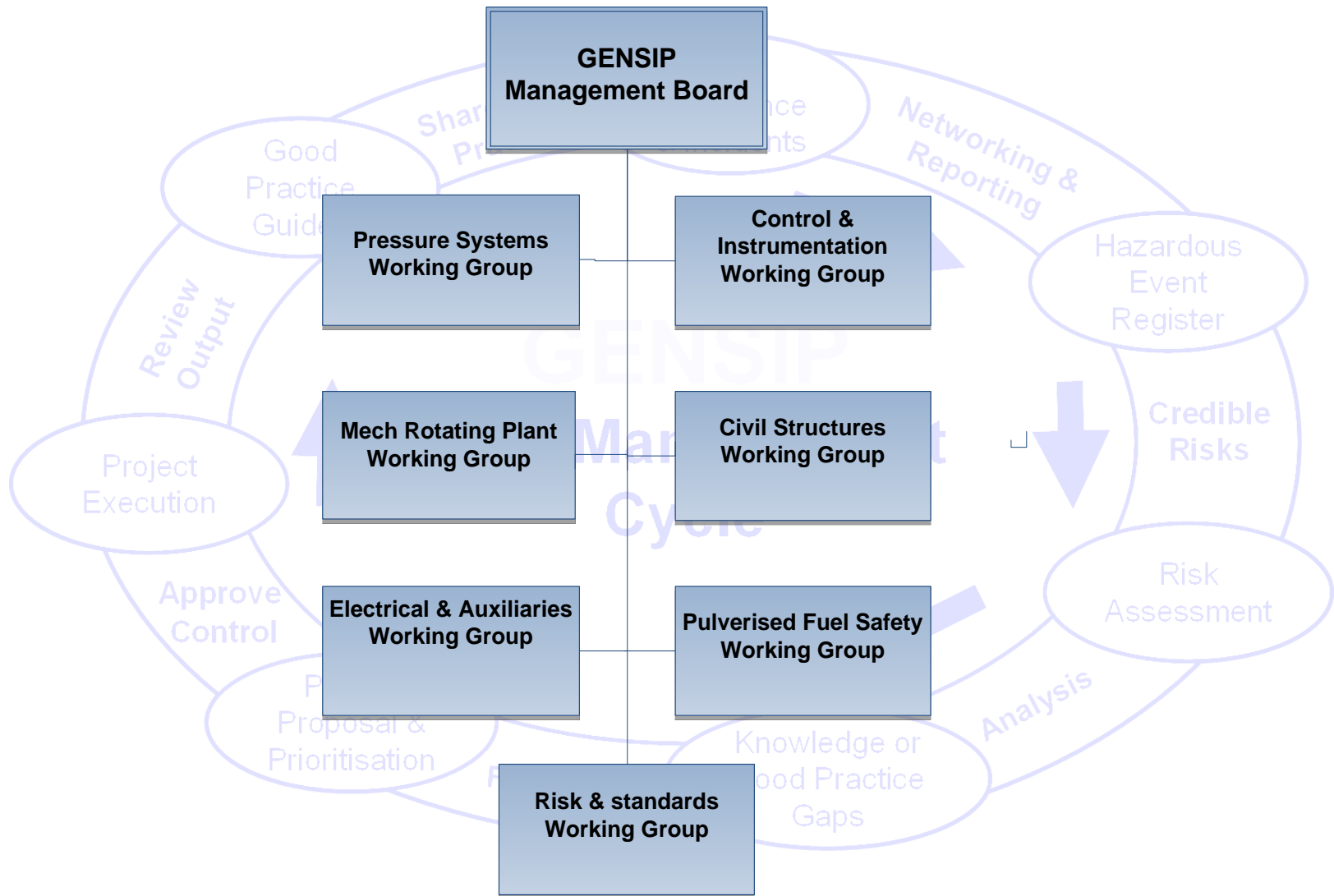
Event Frequency		
1	Remote risk with current mitigations	0.001
2	Possibility but no expectation	0.01
3	Expectation in the UK in 10 years	0.1
4	Expectation in the UK in a year	1
5	Expectation more than once a year	10

Potential Fatalities
1
3
10

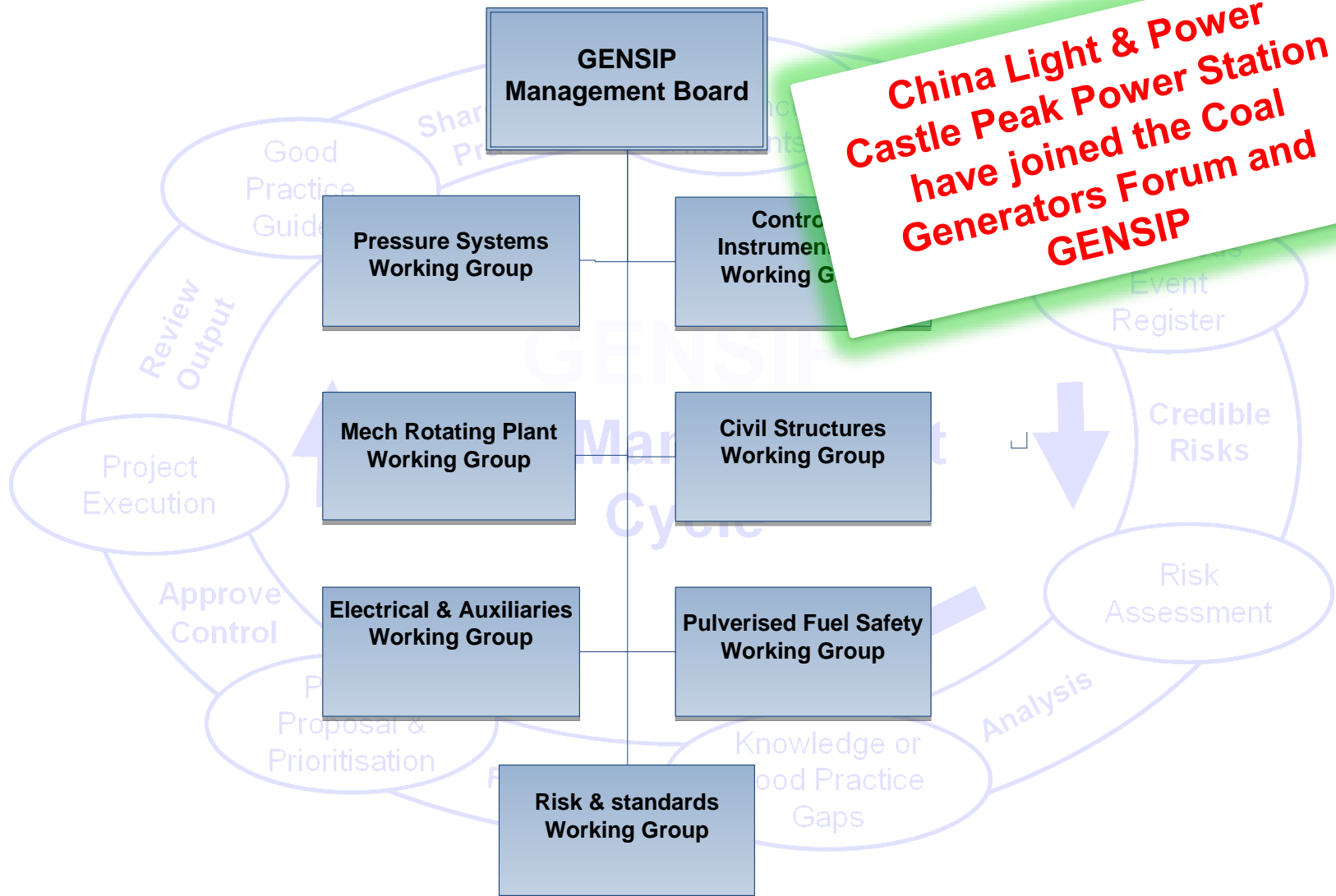
Conditional Probability
0.001
0.01
0.1
1

Hazardous Event	EF		PF	CP	Product
Collapse of walkways and gratings	3	0.1	1	1	0.1
Falling claddings and objects from buildings	5	10	1	0.001	0.01

# GENSIP Process



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# GENSIP Process Timeline

December: HER review and publish. (SWG's provide HER and RAF updates)

End December: Project Proposals/new RAFs to the Risk and Standards WG

End January: Project Proposals assessed and approved by Management Board

End February: CGF approve following year's Business Plan

April: New Business Plan implemented

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# GENSIP 2013/14 Work Programmes

Programme Title	HER Ranking
ALARP Updating	n/a
Management of Boiler Headers	0.006
Seminar	n/a
Phased Array Ultrasonic Testing	0.01
Furnace safety	0.01
PF Code Of Practice reqs doc	0.01
Process facilitation	n/a
Electronic Data Management System	n/a
Incident database	n/a
ALARP matrix calibration	n/a
Assessment of Gensip Hazard management measures using Bow Tie analysis	n/a
Site Safety File guidance and template	n/a
Produce guidance and template for HAZARD studies	n/a
Cyber security	n/a
Fire Protection Completion	0.001

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# GPGs and ALARP

- A GPG is a statement of good practice
- The guidance should be prepared in the spirit of ALARP, thus challenging what more could be done to reduce risk and advocating new measures based on proportionality.
- However, ALARP itself is a legal obligation on an individual Duty Holder and is site specific. What is not proportionate at one site may be proportionate elsewhere if risks are higher.  
GENSIP Safety Alerts
- GENSIP developed a guidance document on ALARP

## GENSIP Documents approved

GPG C1001 alarm management

GPG CS001 Management of Building Cladding & Roofing

GPG EA 001 Operation & Maintenance of Electrical Switchgear

GPG EA 002 Management and Maintenance of Transformer Bushings

GPG EA 003 Management and Maintenance of Electrical Earthing Systems

GPG PF001 DSEAR Good Practice Guide

GPG PS001 CMV Pipework Management in Conventional UK Power Stations

GPG PS002 Integrity Management and Risk Control of Steam and Water Pipework in Conventional UK Power Stations

GPG PS002 management of CMn cold formed bends issue

GPG PS004 Managing Risks from External Boiler Tube Failures in conventional UK power stations

GPG PS005 Integrity management of deaerator storage vessels in UK conventional power stations

GPG PS006 Hydraulic test waivers

GPG RP001 Overspeed Testing of Steam and Aero Gas Turbine Generators

GPG RP002 The Management of Threaded Fasteners Operating at Temperatures above 370°C

GPG RP003 Managing the Integrity of Low Temperature Steam Turbine Rotors and Blading

GPG RA001 Guide to ALARP

GPG CI002 The management of legacy systems

GPG CS 003 assessment and inspection of coal conveyor structures

## **GENSIP Published Technical Reports**

Risks Associated With Outage Activities

GENSIP Guide to ALARP

FMJL Current Transformers FMVG Current Voltage Transformers.pdf

History Switchgear Flash Over Incidents

Remnant life assessment tool for cracked C-Mn cold formed bends

Switch gear failure mode

Interim specification for modified chrome steel for use in conventional power stations

GENSIP Review Report - ABB 3rd Party Review of GENSIP Risk Assessment Process.

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## **GENSIP Process Safety Alerts**

GPSA 04 HSE Alert Corrosion fatigue failure of tubes in water tube boilers.doc

GPSA 05 TEN027\_V10\_Shell Boiler Endplate and Gusset Stay Cracking.pdf

GPSA 06 Safety Alert Long Bolt Flange Design.pdf

GPSA 07 FMJL CT Failure.doc

GPSA 08 Drax Boiler PFS Pipe-work Cracking MAY10.pdf

GPSA 09 Main Steam - Hot Reheat Bend Replacement Issue.pdf

GPSA 10 Fire in 11kV Switch Room - Kingsnorth.pdf

GPSA 11\_11kV ABB VD4 Vacuum Circuit Breaker Failure.pdf

GPSA 12\_AEP Incident Report Drax Whip and Bourne 3\_3kv incident (Part 1 of 2).pdf

GPSA 12\_Madison A3283 MSD Shutter Linkage Fault Description (Part 2 of 2).pdf

GPSA 13 NEDeRS DIN 2011000600 \_NEW\_\_Circuit Breaker\_HWX\_GEC Alsthom.pdf

GPSA 14 Transformer Failure.pdf

GPSA02 Gensip\_-\_Ash\_Grab\_-\_reproduced\_PPT.pdf

GPSA03 AEP Incident Report Drax Whip and Bourne 3\_3kv incident.doc

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## Terms of Reference – *the future ...*

A number of integrity risks associated with Generation Plant currently exist, or are likely to emerge, in addition to those associated with ageing coal fired power stations. Some examples are included below:

- ageing Combined Cycle Gas Turbine (CCGT) Plant
- two-shifting impact on CCGT Plant
- wind turbine plant (whole life-cycle)
- plant de-commissioning or preservation
- new build generation plant
- new technology associated with Generation Plant (alternative fuels, abatement)

The relevance and priority of such risks will vary considerably between each member company depending on their fleet and forward development intent such as life extension, conversion or utilisation of new technologies. It is however considered that sufficient synergies will exist across a number of member company's to support a wider scope to only those associated with ageing coal plants.