



meridian

Wind Turbine Safety Rules

Building a Better Permit System

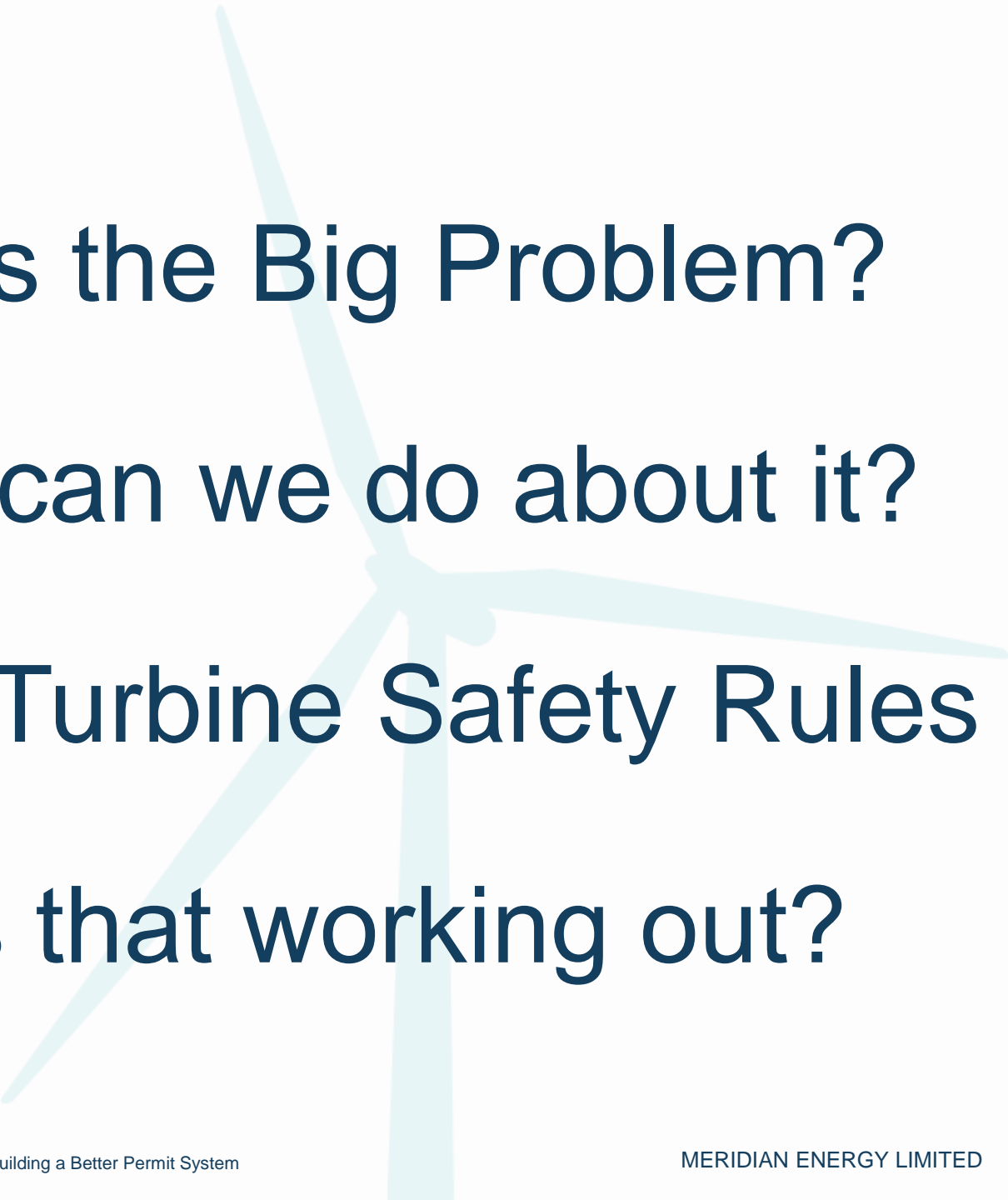
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Wind Asset Maintenance

Meridian Energy

15 April 2014 – New Zealand Wind Energy Conference – Wellington

- 
1. What's the Big Problem?
 2. What can we do about it?
 3. Wind Turbine Safety Rules
 4. How's that working out?



1. What's the Big Problem?

- Complex Systems + Fatal Hazards

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The Pike River Royal Commission

“Major change required and fast”

The Pike River tragedy contains lessons for government, regulators, employers and workers, especially in **high-hazard industries** such as coal mining, where the frequency of major accidents is low, but **accidents can have catastrophic results.**

(Pike River Report Volume 1, page 29)



PIKE RIVER REPORT

The underlying causes

- This was a process safety accident...
- Such problems coincided with **inadequate oversight**...
- The legal framework for health and safety ... is deficient.

(Pike River Report Volume 1, page 15)

Conclusions

New Zealand has a **poor overall health and safety record** compared with other advanced countries. In relation to underground coal mining New Zealand has had a **tragedy every generation or so**, after the lessons of previous tragedies have been forgotten. **This time the lessons must be remembered...**

(Pike River Report Volume 1, page 35)

Solution – The Right Stuff?



Just make sure you're not hiring a bunch of muppets...



Problem solved! What's the worst that could happen?

... actually, quite a lot could happen



“In high hazard industries... accidents can have catastrophic results”

Luckily someone solved this problem nearly 80 years ago...



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17 July 1935 “The Flying Fortress” Boeing Model 299



First public display – a shoe-in to get the US Army contract.

28 July 1935 “The Flying Fortress” Boeing Model 299



Crashed during ‘just a formality’ demonstration flight

28 July 1935 “The Flying Fortress” Boeing Model 299



“Too much plane for one man to fly”

Boeing’s innovative solution:

- Flight procedure checklists,
- Risk assessments,
- Maintenance & servicing checklists ...

15 April 2014

How this translates into Industrial Safety:



“In high hazard industries... accidents can have catastrophic results”

The industrial safety solution:

- Work procedure checklists,
- Risk assessments,
- Maintenance & servicing checklists ...

Doesn't SM-EI already have that covered?

SM-EI = **Safety Manual for the Electricity Industry**
("orange and blue books")
= Rules for high voltage work
(over 1000 VAC or 1500 VDC)



Rules for SM-EI **Access Permits** and **Test Permits**: (a bit simplistic)

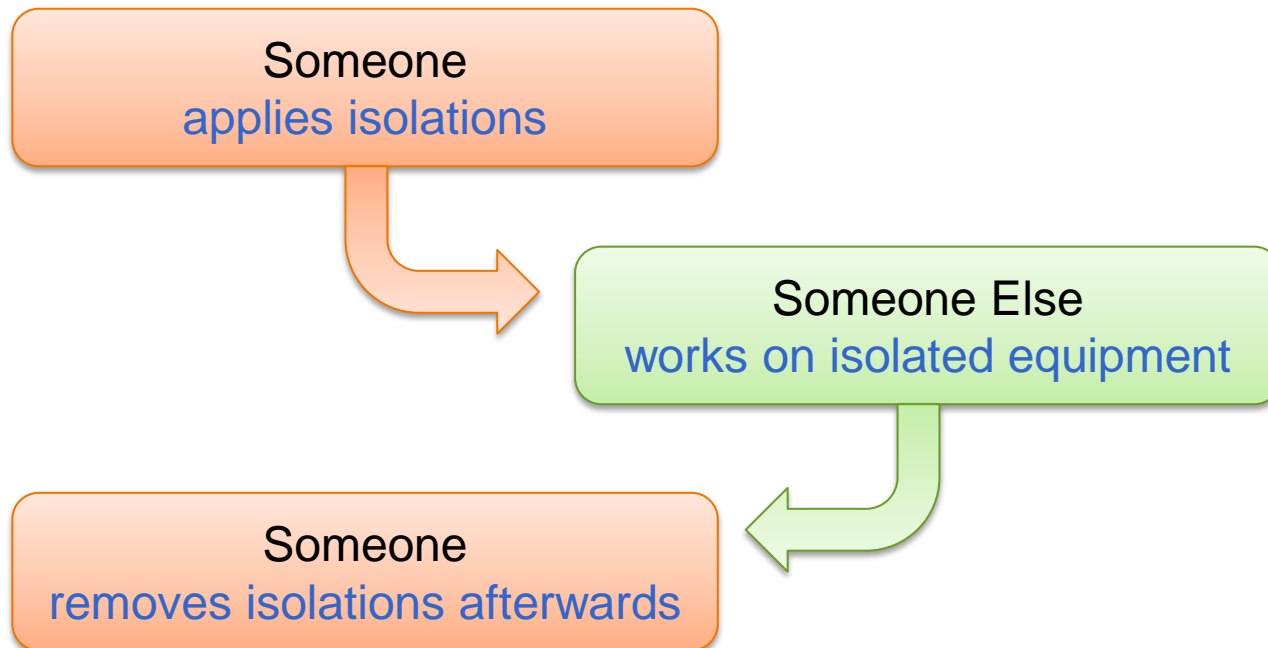
1. Agree on isolations and safety measures.
2. **Isolate equipment**, give an “**assurance**” that safety measures are in place.
3. The **permit issuer** hands a **permit** to the **recipient**.
 4. The **recipient supervises work** within the scope of the permit.
“sign on” to the permit, “sign off” when you’re done.
 5. The permit recipient returns the permit to the issuer.
6. The issuer **cancels the permit** and arranges to **remove isolations**.

Doesn't SM-EI already have that covered?

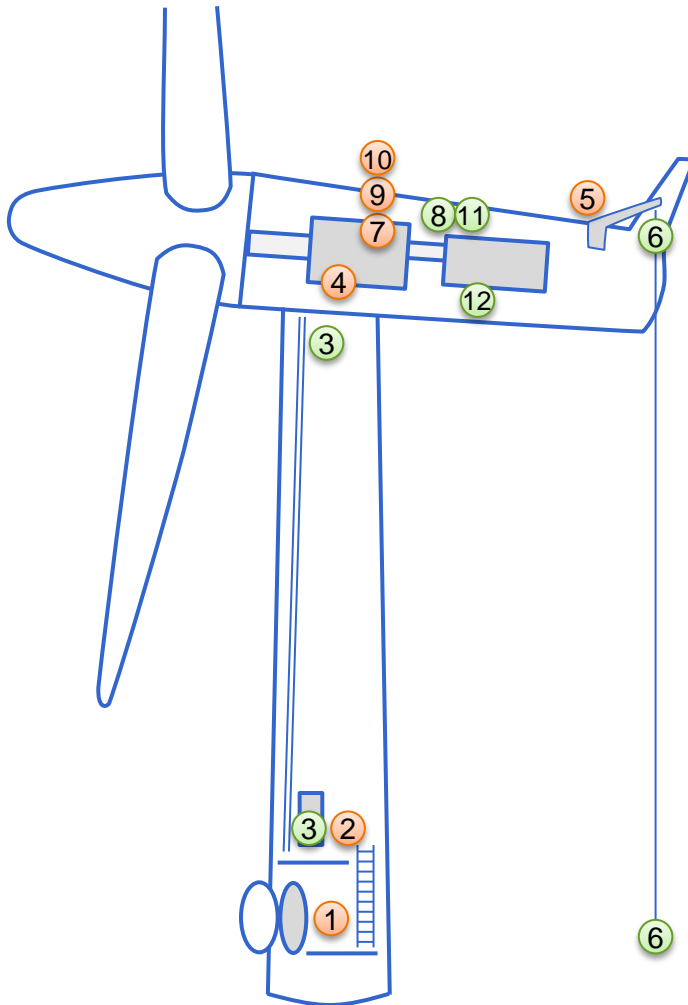
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Rules for SM-EI **Access Permits** and **Test Permits**: (a bit simplistic)



How it works in a wind turbine



1. Enter turbine, switch to LOCAL control

2. Service lift pre-use checks

3. Safe to ascend to nacelle

4. Switch nacelle hydraulics to SERVICE

5. Service crane pre-use checks

6. Safe to use crane, lift gear up to nacelle

7. Insert high speed rotor locking pins

8. Safe to remove covers to coupling,
Take a reading with laser alignment gear

9. Remove high speed rotor locks,
Rotate shaft 90 degrees

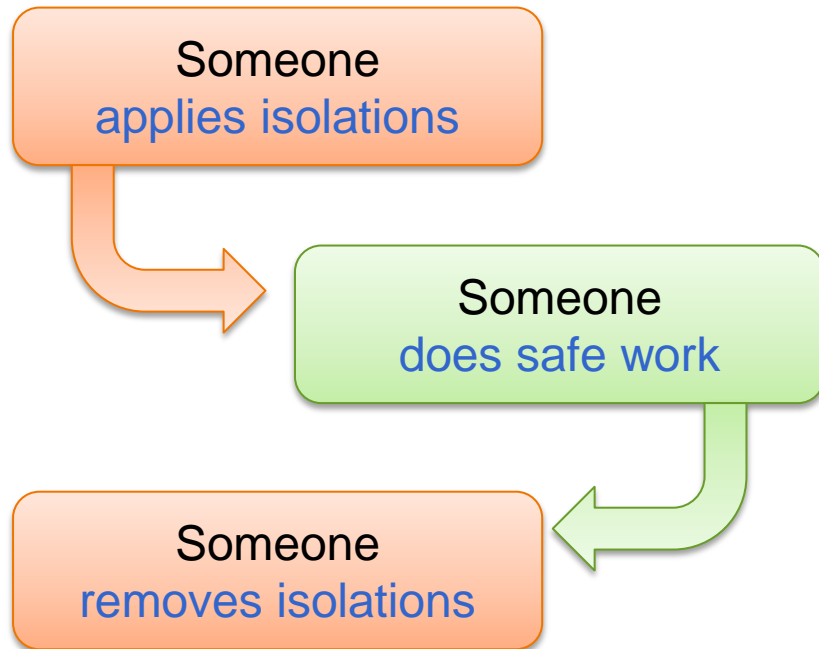
10. Insert high speed rotor locking pins

11. Take another laser alignment reading

12. Shim the generator into position

... and so on...

SM-EI permit system



Wind turbine maintenance

1. Enter turbine, switch to LOCAL control
2. Service lift pre-use checks
3. Safe to ascend to nacelle
4. Switch nacelle hydraulics to SERVICE
5. Service crane pre-use checks
6. Safe to use crane, lift gear up to nacelle
7. Insert high speed rotor locking pins
8. Safe to remove covers to coupling, Take a reading with laser alignment gear
9. Remove high speed rotor locks, Rotate shaft 90 degrees
10. Insert high speed rotor locking pins
11. Take another laser alignment reading
12. Shim the generator into position

SM-EI just isn't designed for wind turbine maintenance

SM-EI permit system **and** Wind Turbine Safety Rules

Essential requirements:

1. Work control and management system (plan work, issue permits, log activity)
2. Employee competency
3. Effective communication
4. Hazard identification (+ worksite safety plans)
5. Hazard controls (isolations + critical safety steps)
6. Backup controls (audits, training, H&S rep, etc)

The basic principles are the same – There is no conflict
WTSR is not in breach of SM-EI or any other regulations



1. What's the Big Problem?

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2. What can we do about it?

- Safety checklists and permit systems

3. Wind Turbine Safety Rules

- A safety system designed for wind

4. How's that working out?

What *Meridian's* Wind Turbine Safety Rules looks like:

- A copy of the “**Rules**” of the Wind Turbine Safety Rules, 48 pages (based on version 3 of the ‘guidance document’ provided by RenewableUK)
- A set of **Management Instructions** – guidance on how to apply the Rules.
- Work documentation:

AWPs

(Approved Written Procedures)

- A checklist of safety steps
- Tick and sign as you go

Method Statements

- Summarises the job hazards and controls
- Sign onto this as the safety plan

Work Instructions

- How to actually do the job.

JSAs

(Job Safety Analysis)
i.e. risk assessments

- Summarised in the Method Statement
- Keep this on file as reference in case anyone needs a detailed look.

Approved Written Procedure (AWP)

- Contains only the essential safety steps
 - Tick as you perform the steps
 - Reference to WI work instructions
- Arranged in blocks
 - Sign when you have completed a block
 - It is now safe to go on to the next bit
- Use of colours

- Yellow caution statements
- Red Lock Out Tag Out isolations
- Grey signature checkpoints
- Green = safe to do something
- Blue = special permit
- Orange Restoration of Motive Power

(temporarily remove an isolation – like the SM-EI “test permit”)

3.0 Enter nacelle	
3.1	<input type="checkbox"/> Conduct pre-use checks for service lift as per WI 001 and Skyman manual in lift.
3.2	<input type="checkbox"/> Record lift hours: – Ascend tower – Enter nacelle.
3.3	<input type="checkbox"/> Switch valve 252 (blue service brake valve) to 'SERVICE' (up). WI 050
3.4	<input type="checkbox"/> Open nacelle hatches as required – Lock hatch arms over 12 m/s when partly open.
3.5	I Certify that the actions listed above were completed to ensure safe work conditions. Signature Checkpoint: Time:
4.0 Operate service crane (as required)	
4.1	<input type="checkbox"/> Conduct pre-use checks for service crane and all lifting equipment as per WI 050.
4.2	<input type="checkbox"/> Competent personnel only to operate crane/hoist or rig loads.
4.3	I Certify that the actions listed above were completed to ensure safe work conditions. Signature Checkpoint: Time:
4.4	Use service crane to lift gear to the nacelle.
5.0 Apply HS rotor locks	
5.1	<input type="checkbox"/> Check that the shaft/hub is stopped at an appropriate angle for the task.
5.2	<input type="checkbox"/> Check that the blades are pitched to stop position.
5.3	<input checked="" type="checkbox"/> Apply isolation: HS rotor locks. WI 401 As per work instruction WI 401 – Apply Tag
5.4	I Certify that the actions listed above were completed to ensure safe work conditions. Signature Checkpoint: Time:
5.5	Perform work which requires rotor isolation.

3. Switch nacelle hydraulics to SERVICE

4. Service crane pre-use checks

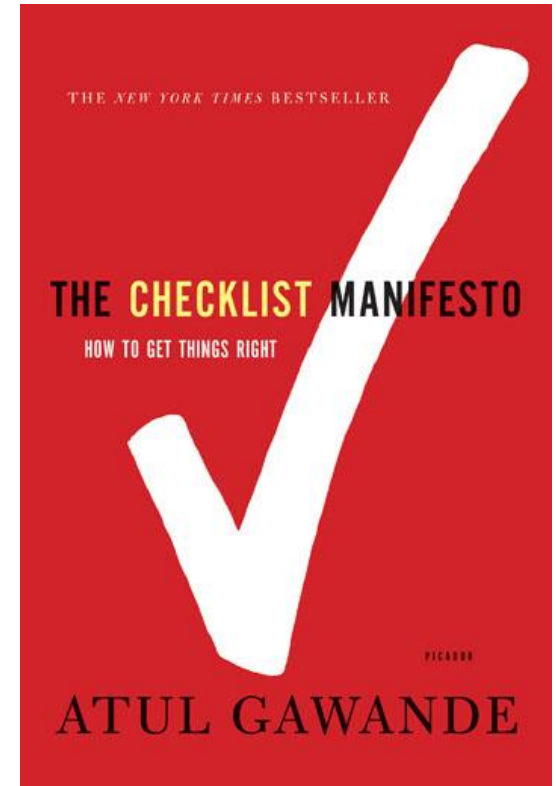
Safe to use crane, lift gear up to nacelle

5. Insert high speed rotor locking pins

Checklist theory

A good checklist looks like this:

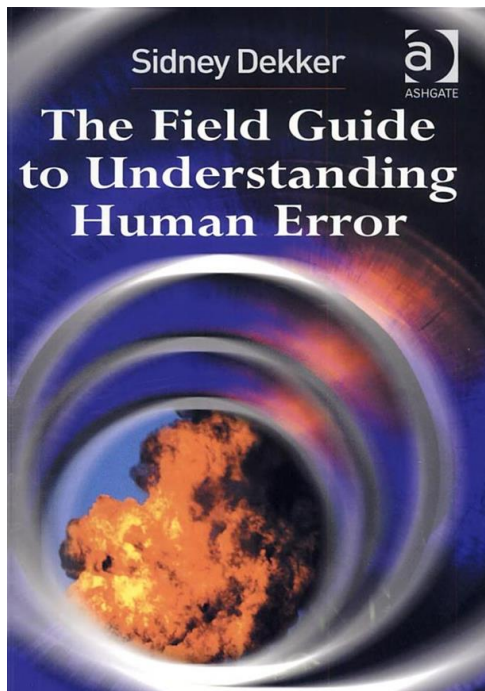
- Every item is actionable and necessary
- Uncluttered, easy to read
- *Minimise* use of colour (not too busy)
- Simple sentences and basic language
- Only essential, critical information (short)
- Structured with fewer than 10 items per 'pause point'
- Written with the audience in mind (don't tell the techs how to suck eggs!)
- A living document – plan for revisions



**awesome
book** 

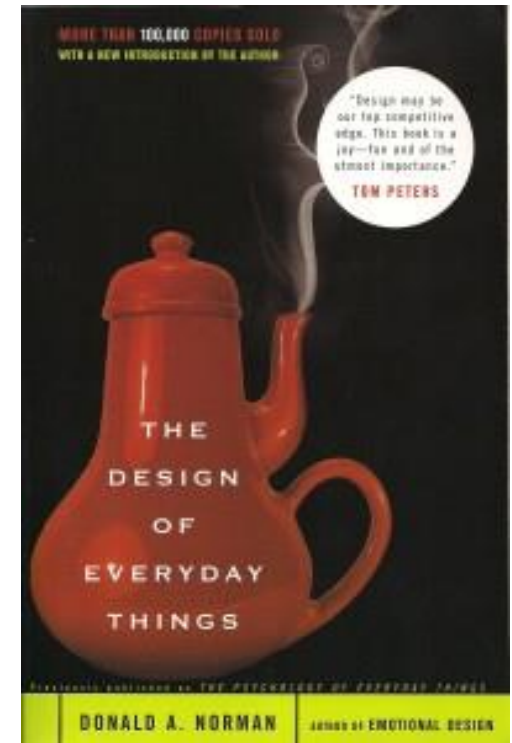
This is important because:

- Human error is often attributable to design error
- Human error should be the starting point of the investigation, not the convenient conclusion
- Complex systems are *not* intrinsically safe (if it weren't for a few unreliable people...)



Bad design kills people

- The “bad apple theory” is a lie – nobody goes to work intending to do a bad job or kill themselves
- Combine good processes with safety culture and safe practices at all levels in your organisation.

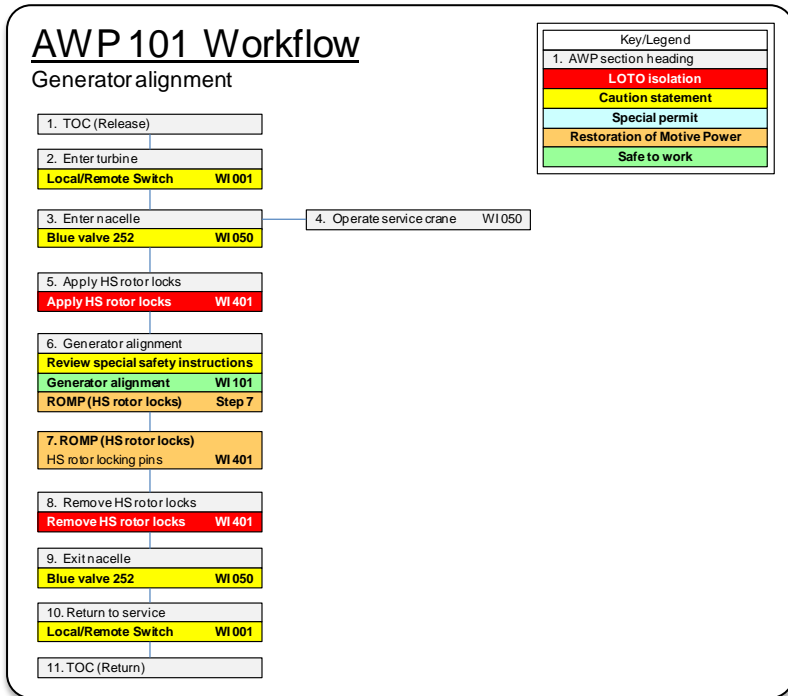


Method Statement

- Summarises the workflow
- Summarises the key hazards and safety precautions
- Safety Plan sign-on with hazard prompts
- Lists all relevant documentation and “brings it all together”

✓

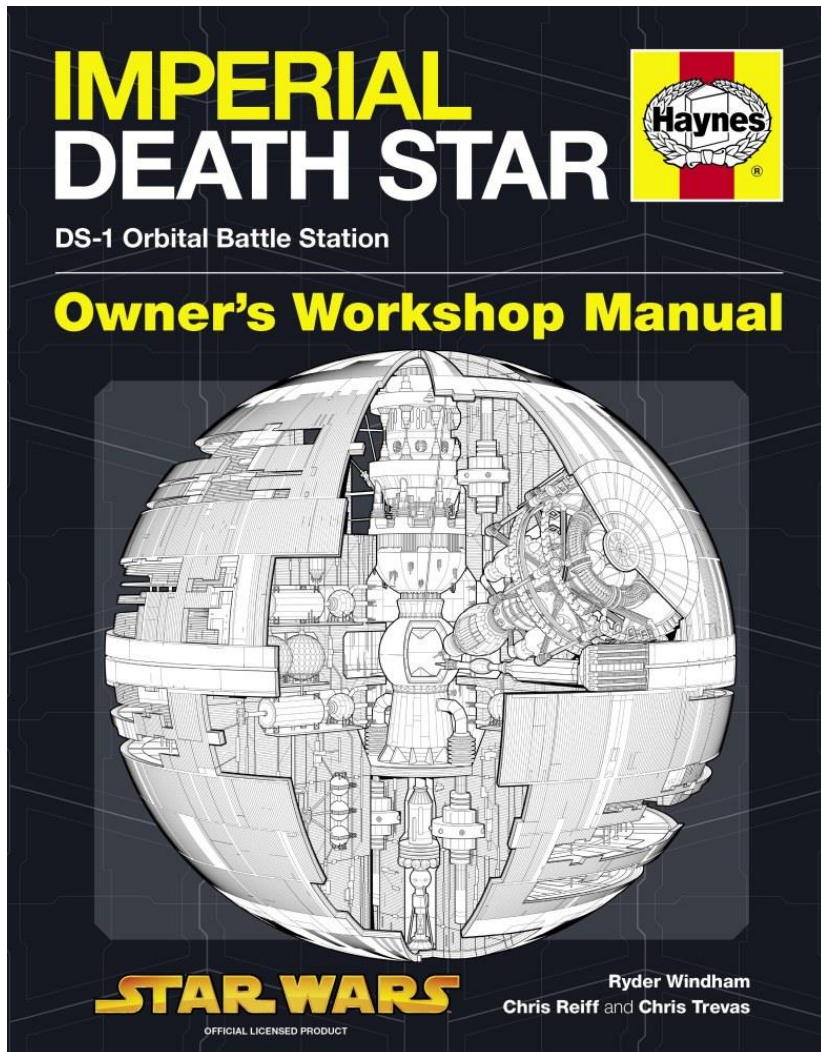
Satisfies all requirements of SM-EI for the Worksite Safety Plan



B. Task-Related Safety Precautions and Controls

JSA risk analysis: overall risk factor after controls are applied =		M	Medium Risk
<i>Update with any additional precautions required on <u>this day</u>, in <u>this turbine</u>, for <u>this work party</u>. Consider: weather, other work parties, special equipment, worker supervision, turbine restrictions, etc.</i>			
Hazard	tick if applicable and significant	Control	
<input type="checkbox"/> Safety from the System		Follow AWP 101 and keep all signature checkpoints up to date.	
<input type="checkbox"/> General PPE requirements		Required at all times: Helmet, safety boots. Required as appropriate: Gloves, eye protection, arm and face protection.	
<input type="checkbox"/> Noise		Use hearing protection at turbine stop/start and as necessary (e.g. power tools)	
<input type="checkbox"/> Trips/slips/falls		Take care in and around the work site. Clean up as you go.	
<input type="checkbox"/> Working at height		Use safety harness and fall arrest system including slider and lanyards.	
<input type="checkbox"/> Objects falling from height		Keep clear of potential drop zone. Use tool lanyards. Wear appropriate PPE.	
<input type="checkbox"/> Crane/hoist operations		Competent personnel only to operate crane/hoist or rig loads.	
<input type="checkbox"/> Electrical supplies		Isolate and de-energize, Lock and Tag, then Prove-Test-Prove before touch.	
<input type="checkbox"/> Mechanical hazards		Be aware of potential pinch/crush hazards. Observe maximum wind speeds for generator alignment and rotor locks. Observe special safety precautions during generator alignment.	
<input type="checkbox"/> Machinery		Take care around machinery. Park safely.	
<input type="checkbox"/> Hydraulic pressure		Do not touch or keep your hands close to hoses/fittings under pressure.	
<input type="checkbox"/> Manual handling/posture		Use correct lifting technique. Plan team lifts. Avoid poor posture where possible.	
<input type="checkbox"/> Other people on site		Check site hazard boards and morning minutes; be aware of others on site. Identify drop zone around the turbine as appropriate, e.g. use road cones or tape.	
<input type="checkbox"/> Chemical hazards/spills		Review MSDS sheets for chemicals. Use appropriate PPE. Use spill kits.	
<input type="checkbox"/> Fire hazards		Sweep and clean up all combustibles. Take extra care in dry/windy conditions.	
<input type="checkbox"/>			
<input type="checkbox"/>			

Work instructions... often plant doesn't have a user manual

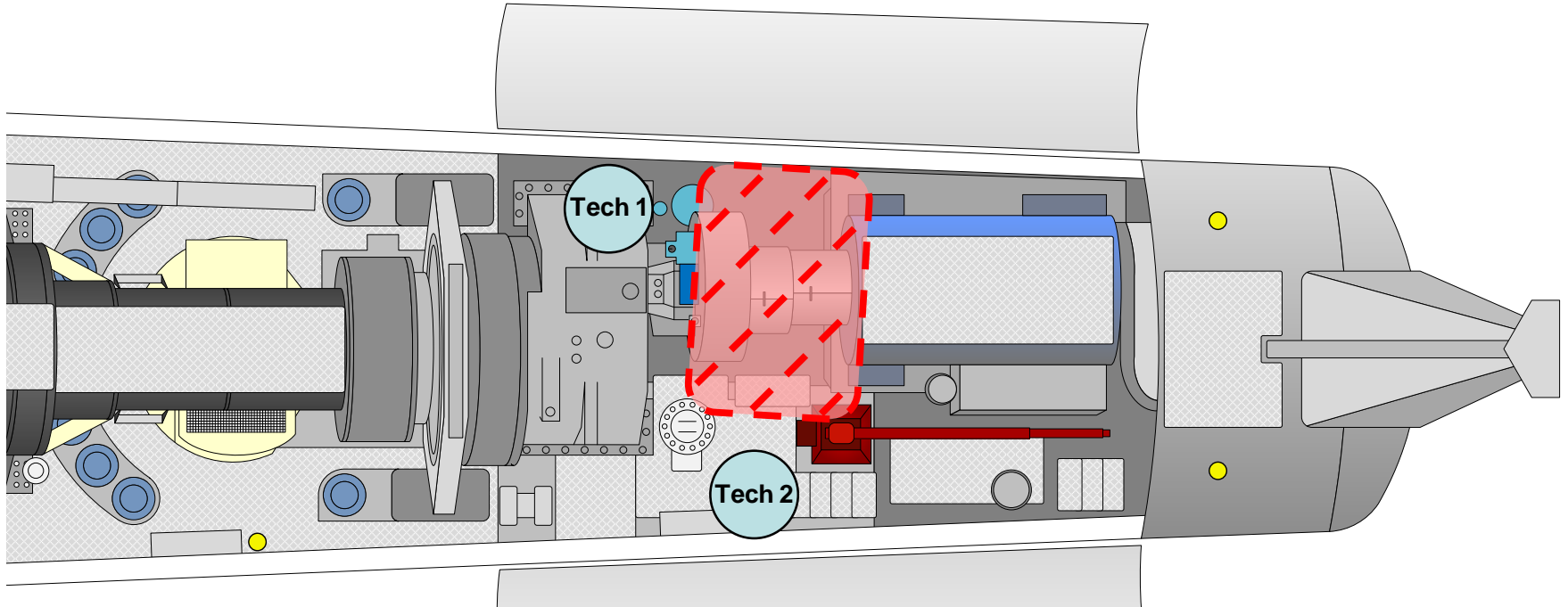


Even if you did find one, the evil empire might sue you for copyright...

... and yet it's quite easy to generate your own intellectual property

Note: Image copyright Haynes Publications used under the "fair dealing" exception of the New Zealand Copyright Act, for educational use with limited distribution. =>

Intellectual Property – Generate your own



Shaded area adjacent to the exposed brake disc is strictly out of bounds when the brake disc upper cover is removed and HS locking pins are not in place.



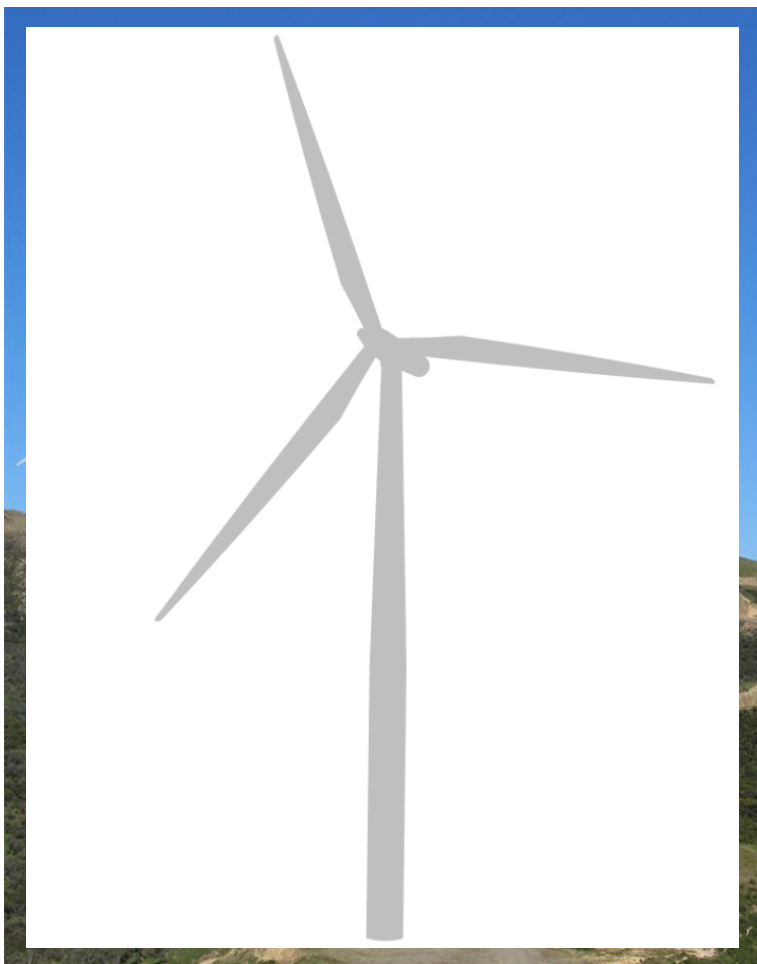
Intellectual Property – Photo of West Wind WWD411



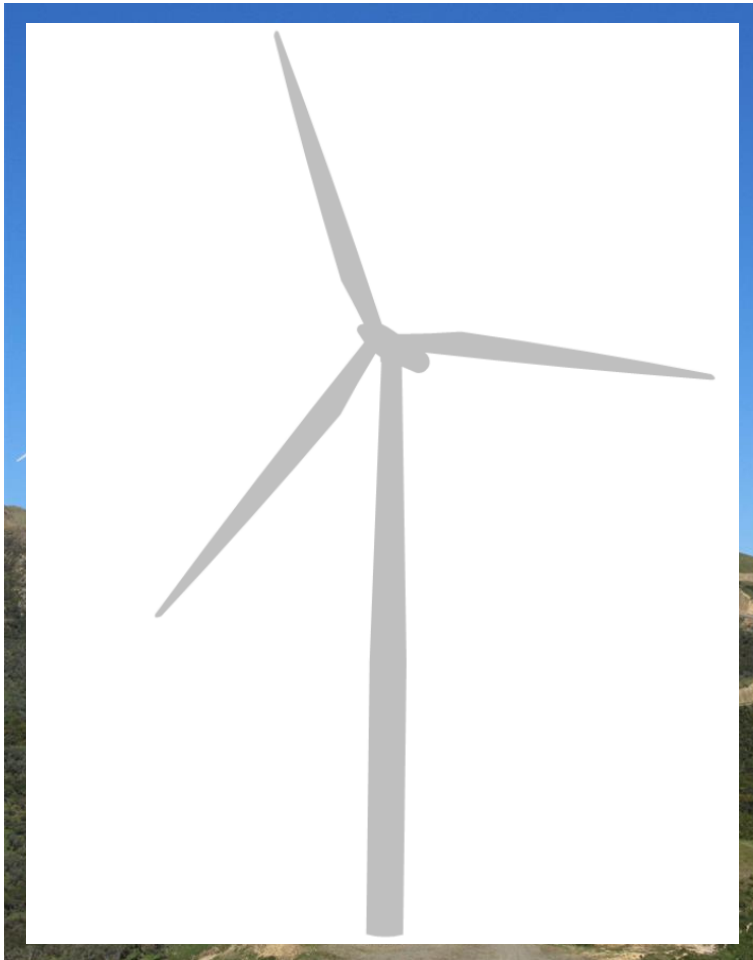
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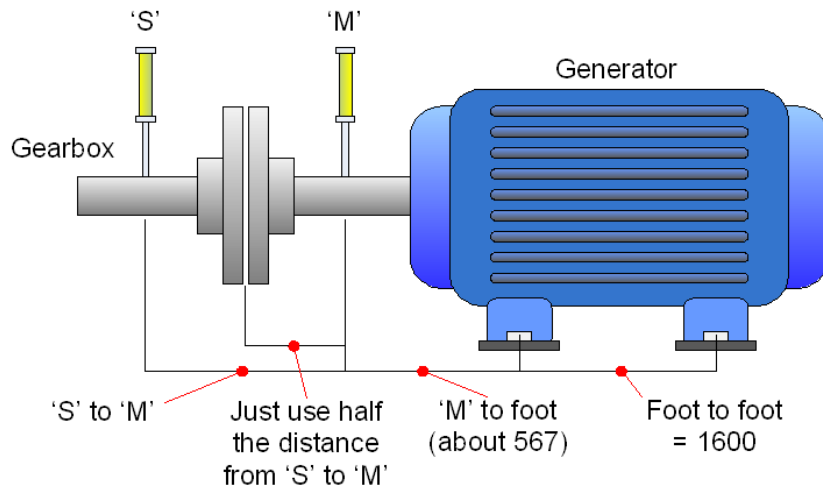
RULES – WEST WIND
CHECKLIST
ALIGNMENT: CH 101



required for alignment:

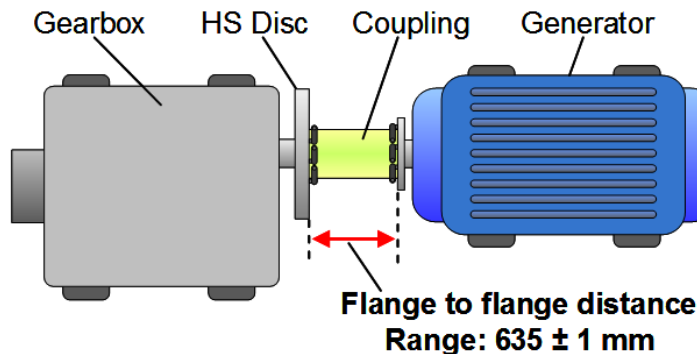
Dimension	Value used
M' (0 mm)	

Intellectual Property – Photo of West Wind WWD411



Dimensions required for alignment:

Dimension	Value used
'S' to 'M' (about 420 mm)	
Half of 'S' to 'M' (about 210 mm)	
'M' to foot (about 567 mm)	
Foot to foot (= 1600 mm)	





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The current state of play...

- Over 120 'approved' WTSR documents right now...
- Many, many more are in the pipeline!
- The West Wind and Te Uku wind farms went live under the new system on 24 Feb 2014
- Mill Creek will operate under the new Rules from Day One
- Plan to eventually roll out to other Meridian wind sites

Issue – The Right Stuff



“Don’t treat us like untrained monkeys...”



Reinforce the message:

Wind Turbine Safety Rules is about...

- Keeping people safe at work
- It’s for the technicians (not for lawyers or management)
- Bring together best practice
- That means *you* get to add *your* bit and help make the system better

DNV-GL accreditation in progress - submitted Oct 2013

“Certification of Service Providers in the Wind Energy Industry”

DNV-GL

(used to be Det Norske Veritas / Germanischer Lloyd / Garrad Hassan)

Part 1 = Audits of:

- Documentation
(procedures, instructions, admin, personnel, resources, technical issues...)
- Quality management system

Part 2 = On-site audits and verification in [May 2014](#)

Simplified Technical English



“What the #%@! is the ‘period key’?
we can’t find that on the hand controller.”



“Press (•) on hand controller”

Once again...
led by the aviation industry



Simplified Technical English, ASD-STE100

Keyword (part of speech)	Approved meaning/ ALTERNATIVES	APPROVED EXAMPLE	Not approved
X severe (adj)	✓ DANGEROUS	HYDRAULIC FLUID IS DANGEROUS FOR YOUR SKIN.	Hydraulic fluid can cause severe skin problems.
✓ SHAKE (v),	To move or cause to move quickly up and down or from side to side	SHAKE THE CONTAINER.	
X shall (v)	✓ MUST	HOLES MUST NOT HAVE SHARP EDGES.	Holes shall not have sharp edges.

Thanks!

Wind Turbine Safety Rules

Building a Better Permit System

Dr. Nathaniel Janke-Gilman

1. Complex Systems + Fatal Hazards = Bang!
2. Use checklists + permit systems for safety
3. Meridian Wind Turbine Safety Rules
 - Built for wind, using smart design principles
4. The system went live in February...
 - Reinforce that “it’s all about safety”
 - DNV-GL accreditation in progress
 - Simplified Technical English as a future direction