GFA Safety Seminar – Gawler Mar 2016

Human Factors

With a focus on “Maintenance” activity

Any one of us can err…….

Human Factors – Maintenance

- "***Human Factors***" in gliding occur and impact because of ***we / us*** (people) involvement.
- "***Human Factors***" have the potential to exist in all aspects of gliding – *Daily Inspection, Glider repair, Annual Inspection, Scheduled or Routine maintenance, Flying, Pilot maintenance activity, Trailering/Hangaring/ repairing gliders, etc etc.*
- "***Human Factors"*** can't be eliminated – **because humans remain fallible** – but they can be somewhat controlled, *if the appropriate attention* is applied.

Human Factors – Maintenance

- Not desirable to eliminate all “Human Factors” - there are some good examples where HF’s have have resulted in positive outcomes (and get widely applauded), including:
  - Capt. Chesley Sullenburger and the A320 Airbus onto the Hudson River, after a bird strike.
    - I wonder did someone ask/list “What went ***right***”.
  - Capt Richard Champion De Crespigny in the Qantas A380 - which suffered an uncontained engine explosion soon after T/O.

US Airways Flight 1549

#2 Rolls Royce Engine, A380

Positive Human Factors

- These two events – and many similar – resulted in NO FATALITIES and (at worst) only minor injuries.
- The focus here is on ***Airworthiness and inspection HF*** aspects for Pilots, Daily Inspectors, Annual Inspectors, etc
  - A simple oversight during a DI could be as disasterous as a simple oversight during an Annual Inspection.
  - The DI may be the last opportunity to find any existing fault .....

Human Factors – Maintenance

- The “appropriate attention” could be provided by the use of;
  - Checklists & written procedures
  - Independent Review and Checking
  - Training
  - Maintaining currency
- Maintenance/Airworthiness activity could be
  - Daily Inspection – the last opportunity to arrest.
  - Annual or Routine Maintenance.
  - Pilot Maintenance (repairing a puncture).

Human Factors

- ***Maintenance*** is a major aspect in <u>every</u> form of aviation, including gliding.
- In the very **Distant Past** – "work" included fitting a shoe onto a horse, where failure had almost no impact or consequence (the horse shoe fell off),

  and - *involved very few people*.
- **Today**, impacts maybe far more reaching – airliners with many hundreds of people aboard (A380).

Benefits in Automation

- In aviation, many safety & reliability improvements have been achieved – a lot of these by automation – **BUT *maintenance is very difficult (if not impossible) to fully automate***.
- There are many areas and tasks which cannot be automated – and HUMANS must continue to be intimately involved.

Human Factors – Maintenance

- **Maintenance outcomes** - both good & bad, continue to rely heavily on Human hands, minds and inputs, BUT .....

  H**uman's remain awfully fallible**.

- **Two significant "maintenance threats"** continue to exist;

1st Significant Threat

- That an **actual** or **potential** failure will not be recognised and be corrected (either partly or fully) before a real failure occurs

  – ie, **an oversight** (a ***Human Factor***).

  - Unintentional

An Example

- **A crack in a bolt is not identified**
  - the bolt is not replaced, and
  - the bolt subsequently fails in service.

2nd Significant Threat

- **The maintenance task itself introduces a failure or increases the risk of failure, which may not have occurred if it weren't for the maintenance activity.**

An Example

- A good part is inspected <u>but</u>
  - is wrongly reassembled, or
  - is wrongly reinstalled, or
  - Is damaged on reassembly / reinstallation

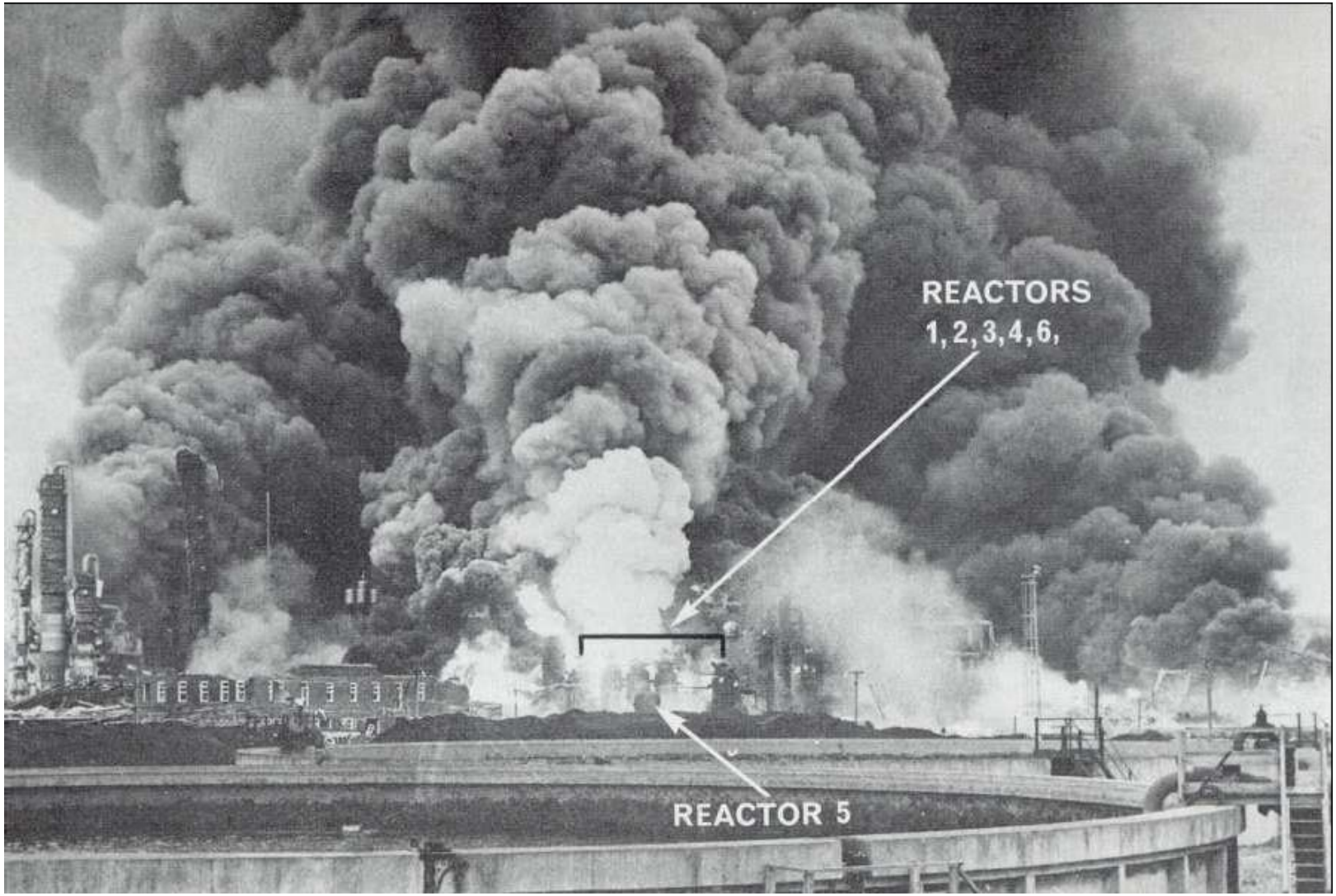
  following the inspection,
- The part subsequently fails after a return to service.
  - another "***Human Factor***".

Human Factors – Maintenance

- Some significant, historical "***Maintenance Error***" (ME) Human Factor events include;
  - **Flixborough** - cyclo-hexane facility in UK, uncontrolled, non approved modifications, 1974.
  - **Bhopal**, India, methyl-iso-cyanate release, 1984.

    (Non approved modifications), killed thousands.
  - **Piper Alpha**, North Sea, uncontrolled maintenance activity, 1988. (Unapproved modifications to systems and Procedures).
  - **Space Shuttle "Challenger",** poor maintenance practices (o'rings).

Flixborough, 1974



Piper Alpha, 1988

Human Factors – Maintenance

- Human "ME" incidents are not generally random events committed by wayward and/or careless, irresponsible individuals.
- These events are also committed by some **very good, highly experienced and competent individuals in** excellent organisations - with the best tools, equipment, systems & procedures, etc. ***The very best people can and do make some of the very worst mistakes*.**
- *There are many factors influencing* ***Human Factor*** *events – which are mostly controllable.*

Human Factors – Maintenance

Distractions – so easy to control

- Bad in Operations (interrupting Daily Inspections, Pre-T/O Checks, etc).
- Also bad in Airworthiness activity –so easy to do – with potentially fatal consequences.
- **We** must avoid interfering, interrupting, distracting, etc

Checklists and Procedures – use them.

Independent Checks – use them,

Pressure – to get flying.

Human Factors – Maintenance

- It is appropriate to address all “aspects” in a system when considering remedial measures:
  - the **individual**, knowledge, experience, training, ability, currency.
  - the **team.**
  - the **task**, frequency (W&B), complexity.
  - the **workplace,** facilities, available light**,** Tools, Procedures (Tool Control), data & information.
  - **Training**
  - **Equipment**

Human Factors – Maintenance

- **Removal** vs **Replacement**;

  - 2 very frequently repeated activities,

  1. **Removal of fasteners,** then

     Replacement of fasteners, ie to remove inspection covers, engine cowls etc.

  2. **Dis-assembly of components,** then

     Re-assembly and **Refitting** of components

- Item 1 is generally easier than Item 2 – but still many mistakes occur with Item 1.
- Lets consider a very simple example,

A Very Simple Example

Consider this model - 1 bolt, with 8 nuts labelled 1 – 8

- **The Task**

  - remove the Nuts from the bolt.

  - replace the Nuts, in the original sequential order.

- ***Only one way to take Nuts off the bolt***.
- **Re-assembly requires thought, planning, checking**, etc

  - 40,000+ ways of getting this sequence ***wrong***

  8x7x6x5x4x3x2x1=40320 - before considering any omissions – cleaning, measuring, under/over tensioning, worn or wrong parts, part integrity, lube, etc, etc).

Human Factors – Maintenance

- **Top 7 causes of in-flight engine shut-down (IFSD) at Boeing :**
- Incomplete installation (33%)
- Damaged on installation (14.5%)
- Improper installation (11%)
- Equipment not installed or missing (11%)
- Foreign Object Damage (FOD) (6.5%) – often tools (Tool Control ?).
- Improper fault isolation, inspection, testing (6%)
- Equipment not activated or deactivated (4%)

Human Factors – Maintenance

- What do you notice about the 7 listed engine shut-down causes ?

Human Factors – Maintenance

- Use written Procedures and Checklists.
- Independent inspection before equipment is closed up.
- Develop and use a “Tool Control” procedure.
- Allow appropriate time to complete the task.
- Don’t a*ssume* someone else did all / part of the job – check carefully.
- Don’t take short-cuts.
  - Don’t accept any ***VIOLATIONS***.
- Conduct Functional Checks- thoroughly.

Human Factors – Maintenance

- Humans – "***we can't easily avoid actions we did not intend to commit***".
- ***"Everyone needs to be accountable for their errors. If the error maker does not acknowledge and report the error and strive to avoid a reoccurrence, then no lesson has been learned and little or nothing is gained from the experience"***
- We must all learn from the errors and experience of others – ***we won't live long enough to learn all the lessons ourselves***.

Human Factors – Maintenance

- Report all incidents – consider them “Free Lessons” - we can all learn from these.

Daily Inspector Rating

- Generally the first Airworthiness Rating a glider pilot obtains.
- The DI should be a lot more that a tyre kicking exercise – it is the last chance to identify any airworthiness issues with the a/c before it flies.
- When conducting a DI, do it thoroughly, systematically WITHOUT DISTRACTIONS.
- DI Examiners – expect high standards, don't accept mediocre performances.

HUMAN FACTORS

SAFETY IN GLIDING IS NO ACCIDENT