AGEING MANAGEMENT PROGRAM OF KARTINI REACTOR FOR SAFE OPERATION

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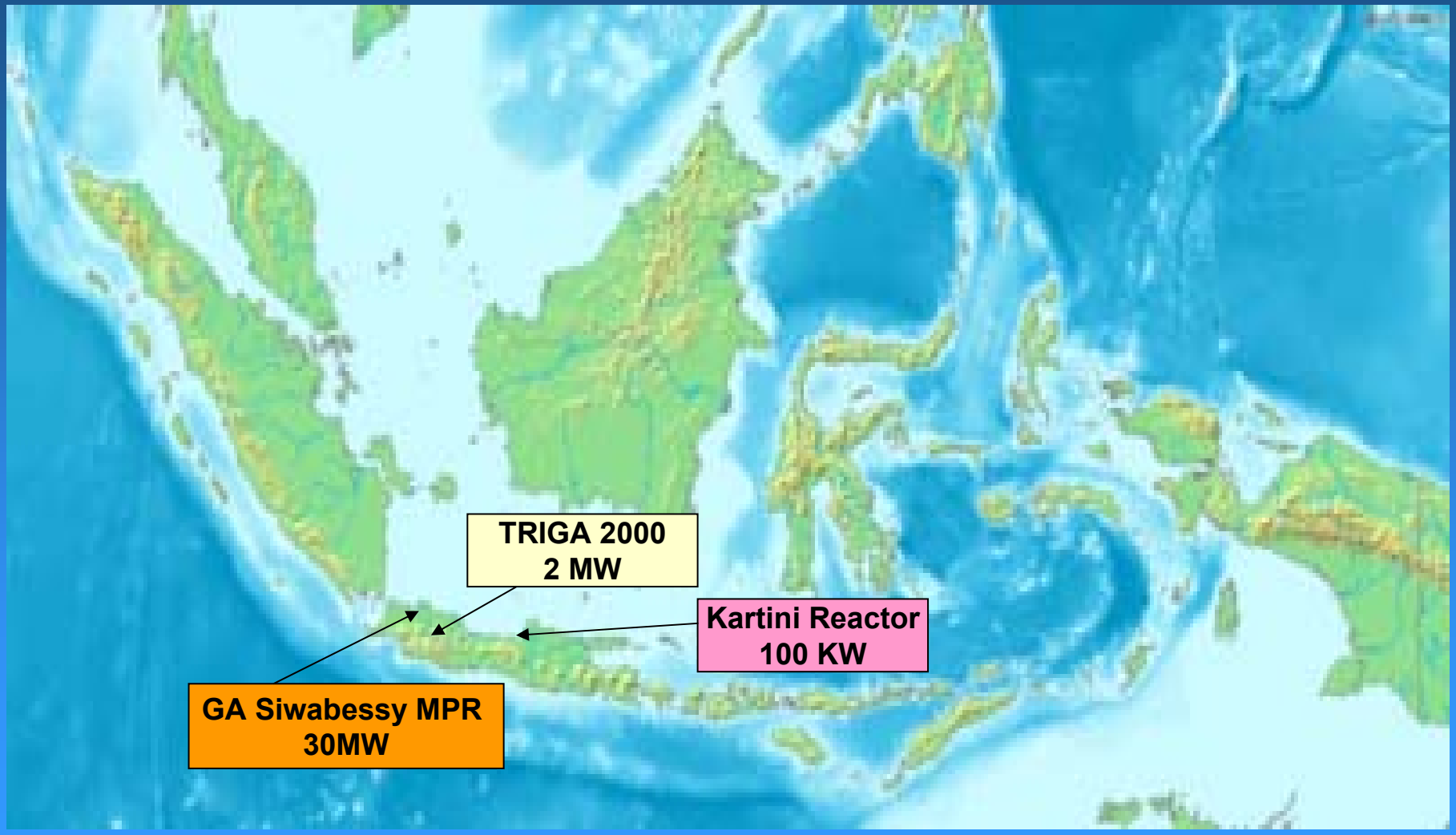
Contents

INTRODUCTION (1)



INTRODUCTION (2)

- Kartini Reactor has been in operation 28 years (critical in 1979)
- TRIGA MARK II, open pool, 100 KW
- Constructed 1050 AL (99.5% Al), 6 mm thickness
- Ageing management program implemented
- Maintenance, monitoring & ISI of SSCs
- Tank liner, core support structure, HE tubes, etc

INTRODUCTION (3)

- Discusses AMP tank liner through inspection
- Since 2001- 2006 by BATAN-supervision by IAEA experts
- Two swelling features seen on the bottom of tank
- Swelling as a consequence of ageing, rate of swelling has decreased, the features are now stable in size
- Careful analysis & assessment root causes swelling indicated they do not present a threat to future safe op.
- Reactor is considered to be in good condition and safe for continued operation

INSPECTION HISTORY (1)

- Firstly 2001 major shutdown used NDT, such as: visual, UT, DP, hardness survey and replication
- Visual: tank minor defect, two swelling features on bottom tank & could not be examined in detail
- Not considered a serious issue for future safe operation
- Wall thickness was predominantly in original 6 mm
- A few thickness data were found less 5 mm, uncertain & were considered to be variations due to the original manufacturing process

INSPECTION HISTORY (2)

- Replication of surface defects indicated defects were observed not concern from a safety perspective
- A small crack (6 mm long) was detected by DP in the weld metal of the upper belt
- Crack was examined by replication, was analyzed showed will not cause fracture. Hot tear from welding process
- Hardness values were consistent with published data
- Inspection 2001 reactor tank still in good & safe condition for continued operation

INSPECTION HISTORY (3)

- INS/9/022, 2004 BATAN received new inspection equipment: video scope, UT, ECT, alloy analyzer
- Dec. 2004 & July 2005 detailed re-inspection to reactor tank was conducted
- Concentrated to the areas of interest (swelling) to obtained images & measurements, better assessment the features
- Kartini license expired Nov. 2005, renewal requirements was to demonstrate to BAPETEN reactor was safe for future operation & an operating license could be issued
- Re-inspection conducted again Dec. 2005 and Sept. 2006

METHODS (1)

- NDT method utilized in period 2001 – 2006
- Visual: to assess general condition of reactor tank liner
- UT: to obtain the thickness of tank wall & tank bottom
- Replica technique using dental putty: to provide swelling profile such as height and areas of swelling
- Replica can be applied in dry and wet, measure accurately dimension defects and surface profile

METHODS (2)

- Principle is to make an impression the surface to be examined using dental putty
- First impression is called negative replica
- Using first impression as a mold for the second impression
- An accurate copy of the original surface is produced & is a model of the swelling feature that is to be measure
- Detailed measurement of the swelling profile can be obtained by measuring the height and area of the swelling used height gauge

RESULTS and DISCUSSION (1)

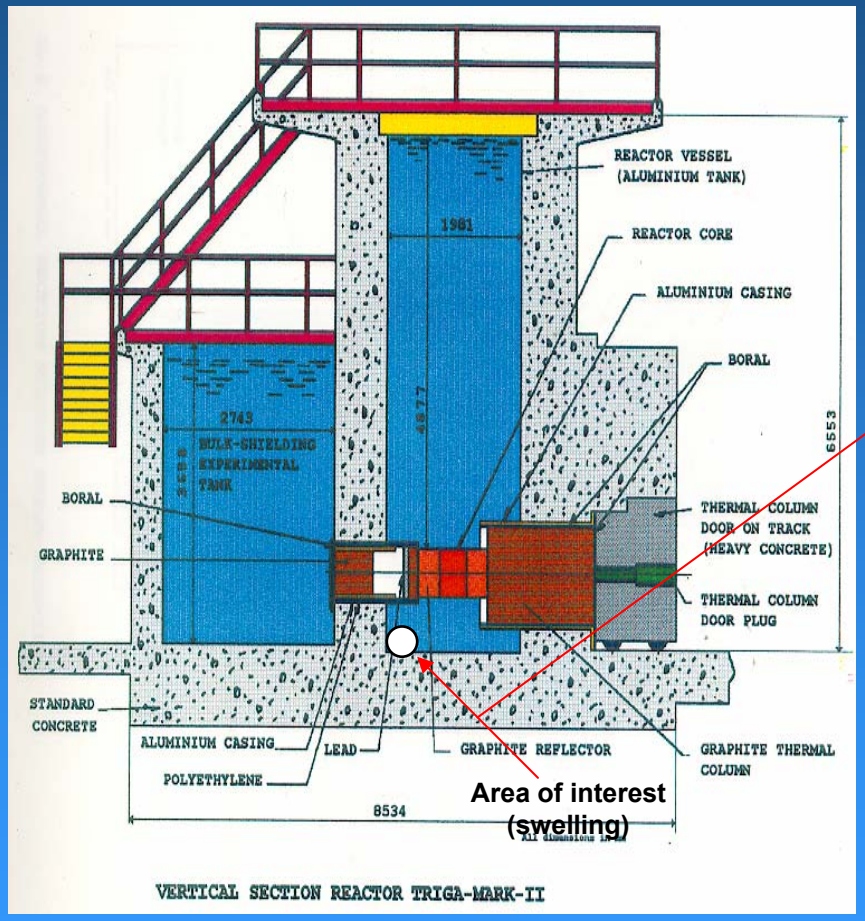


Fig. 1. Vertical Section of Kartini Reactor

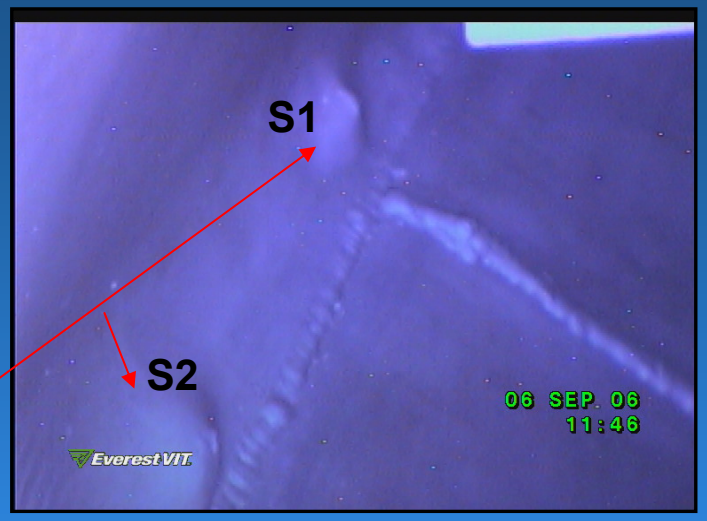


Fig. 2. Swelling features S1 & S2

- **Visual: indicated defect in the reactor were minor and it was observed swellings profiles (S1& S2) on the bottom tank were reaching a finite size**

RESULTS and DISCUSSION (2)

- Thickness measurement of the wall and on the swelling S1 and S2 in ranged between 5.3 – 5.5 mm

- Metal thickness in areas of swelling similar to the wall thickness and to the original metal thickness

Fig. 3. Thickness measurement

Fig. 4.
Replication technique

RESULTS and DISCUSSION (3)

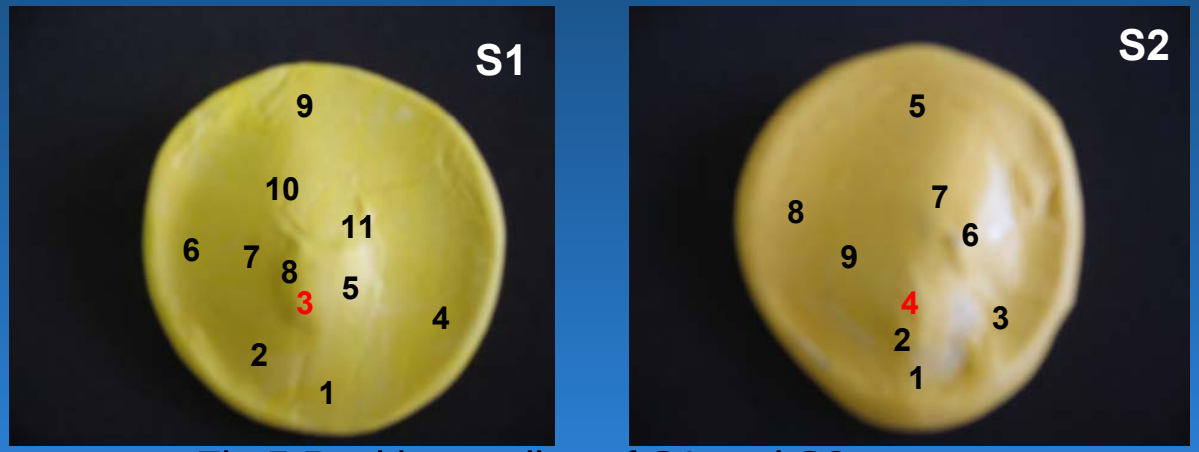


Fig.5.Positive replica of S1 and S2

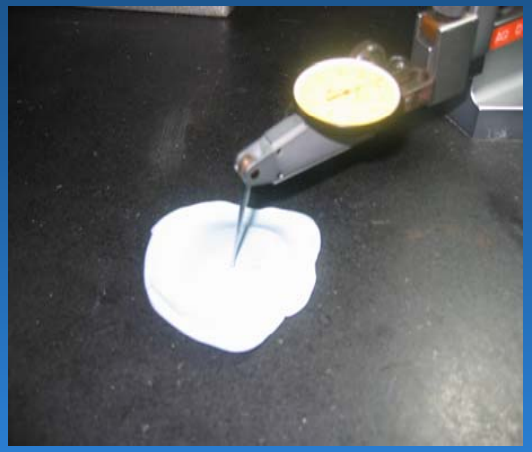
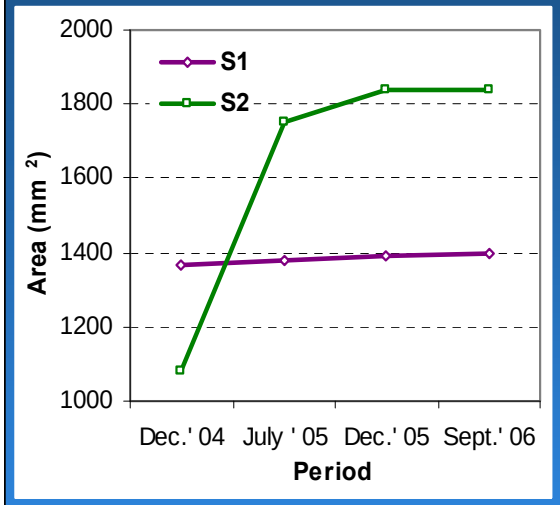


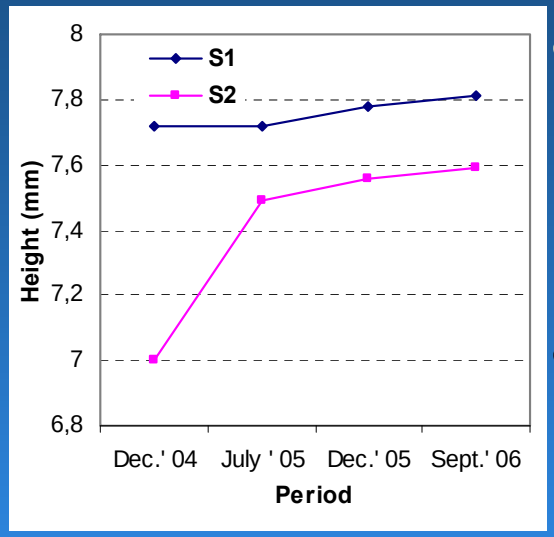
Fig.6.Measurement of swelling height

- **Swelling height measurement conducted on the second impression (surface of pos.replica)**
- **The highest of swelling profiles for S1 in 3, S2 in 4**
- **Graph of S1 and S2 swelling areas and height as function of time shows in Fig.7.**

RESULTS and DISCUSSION (4)



(a)



(b)

Fig.7.Graph of S1 and S2 swelling areas (a) and height (b) as function of time

- Swelling areas and height had grown slowly in size & relatively stable
- Swelling could not be accounted for by formation of corrosion product due to the low "pilling-bedworth ratio" for Al.
- Occurrence swelling was analyzed as ageing consequence
- Obvious some localized pressure is being exerted on the outside of Al tank to create swelling
- RCA of swelling will be discussed by Mr. Syarip.

CONCLUSION (1)

- Swelling has occurred on the bottom as an ageing consequence after 28 years, swelling has shown stopped and has reached its maximum extent on these features
- Inspection regime established for Kartini reactor to monitor the condition of the reactor tank & ensure that reactor is in good condition & safe for continues operation
- Swelling areas will be monitored every 3 months utilizing visual & 6 months utilizing replica and UT

CONCLUSION (2)

- Comprehensive inspection will be conducted every 5 years, thorough regular inspection to determine the condition reactor tank will be conducted
- Over 5 year reg. inspection provided data allowed a prediction the tank condition extending into future operation
- Has demonstrated benefits of ISI & maintenance to ensure continued safe operation of the reactor
- November 2006 received a new 4 years operating license from BAPETEN (Nuc. Energy Control Board of Indonesia)

THANK YOU VERY MUCH

FOR YOUR ATTENTION