2010 AEC-NRC Bilateral Technical Meeting

345kV Startup Transformer Failure (June 12 2009 Mannshan NPP)

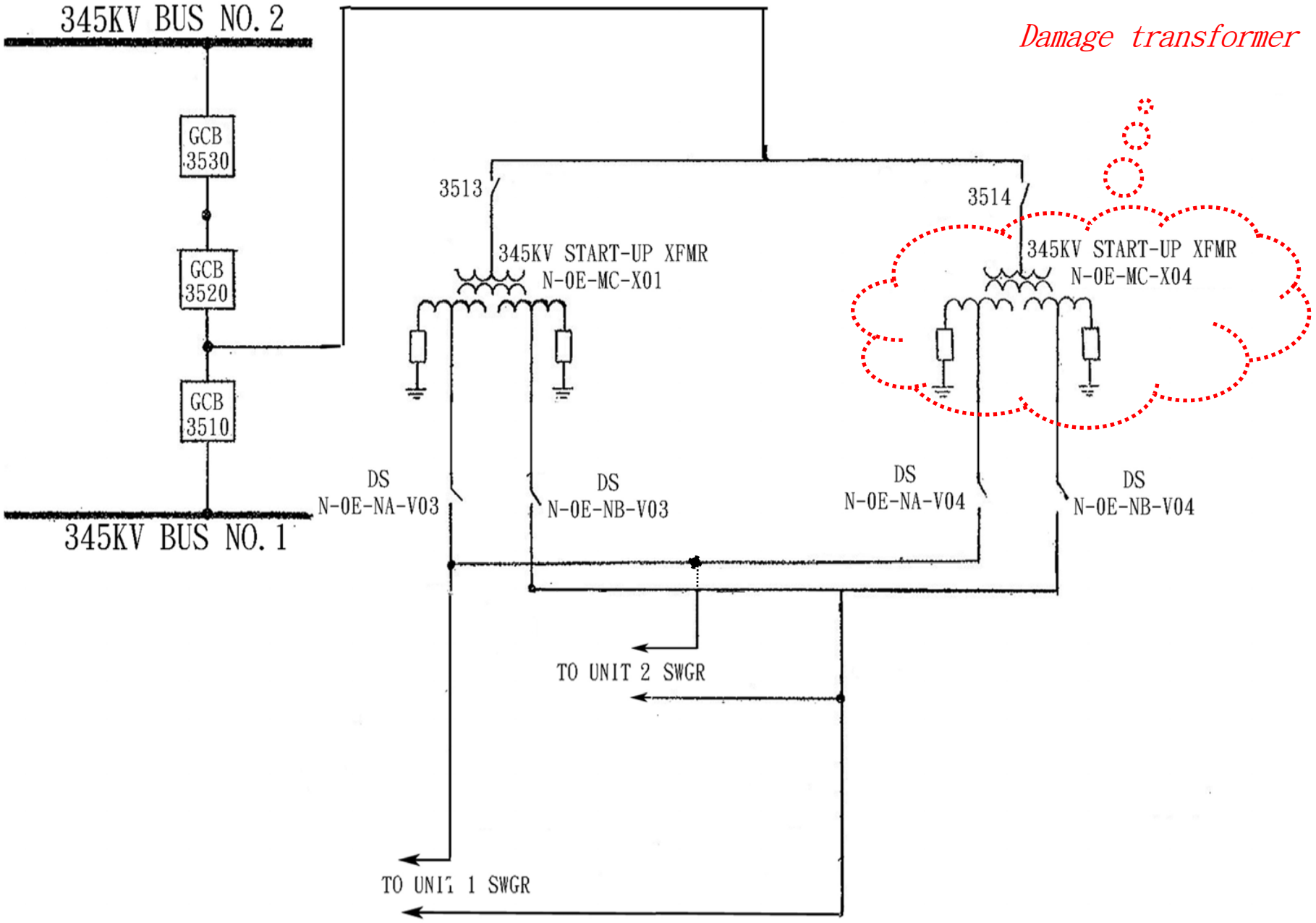
Department of Nuclear Generation

Taiwan Power Company

April 2010

Outline

- Description of 345kV Startup Transformer Failure
- Corrective Actions


345KV BUS NO. 2
GCB 3530
GCB 3520
GCB 3510
345KV BUS NO. 1
3513
3514
345KV START-UP XFMR N-0E-MC-X01
345KV START-UP XFMR N-0E-MC-X04
DS N-0E-NA-V03
DS N-0E-NB-V03
DS N-0E-NA-V04
DS N-0E-NB-V04
TO UNIT 2 SWGR
TO UNIT 1 SWGR
Damage transformer

345kV Starup Transformer

Description of 345kV Startup Transformer Failure

1. The chronological summary of the event on June 12 2009

- 15:13 Differential Relay and Sudden-pressure Relay alarm of the startup transformer MC-X04 actuated in the control room. 345kV startup transformer's breakers automatically tripped , the transformer caught on fire , the sprinkler fire suppression water system was actuated.
- 15:15 &15:18 Station fire brigade and outside fire fighting department were there sequentially .
- 15:26 Operators reduced power of unit 1 and 2 to 90% & 94% rated load respectively.
- 15:48 the fire was completely put out within 35 minutes after the fire broke out.

The 345kV startup transformer on fire

The 345kV startup transformer on fire

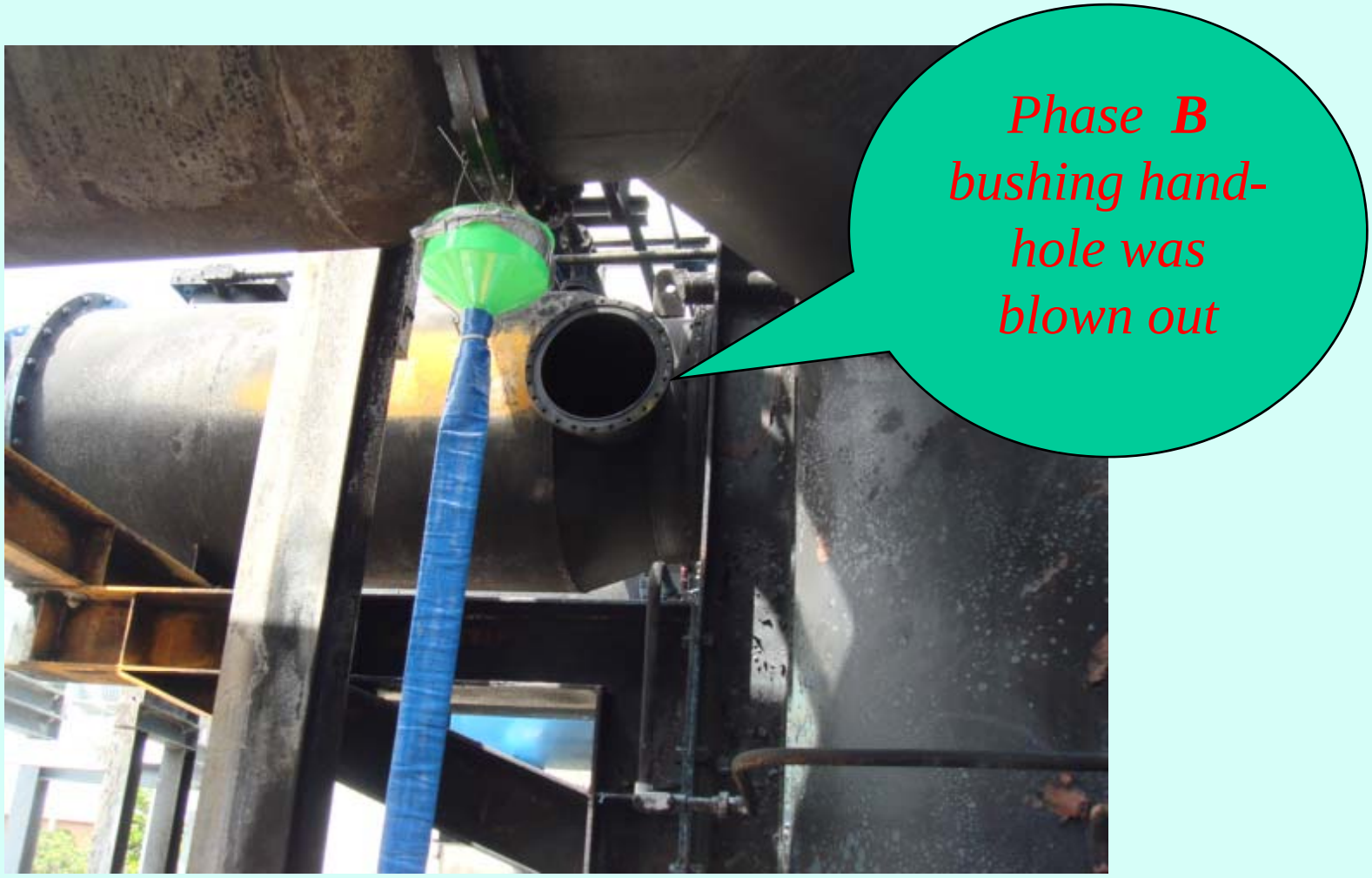
External of the damage 345kV startup transformer after the fire

Description of the 345kV Startup Transformer Failure

2. Root cause investigation

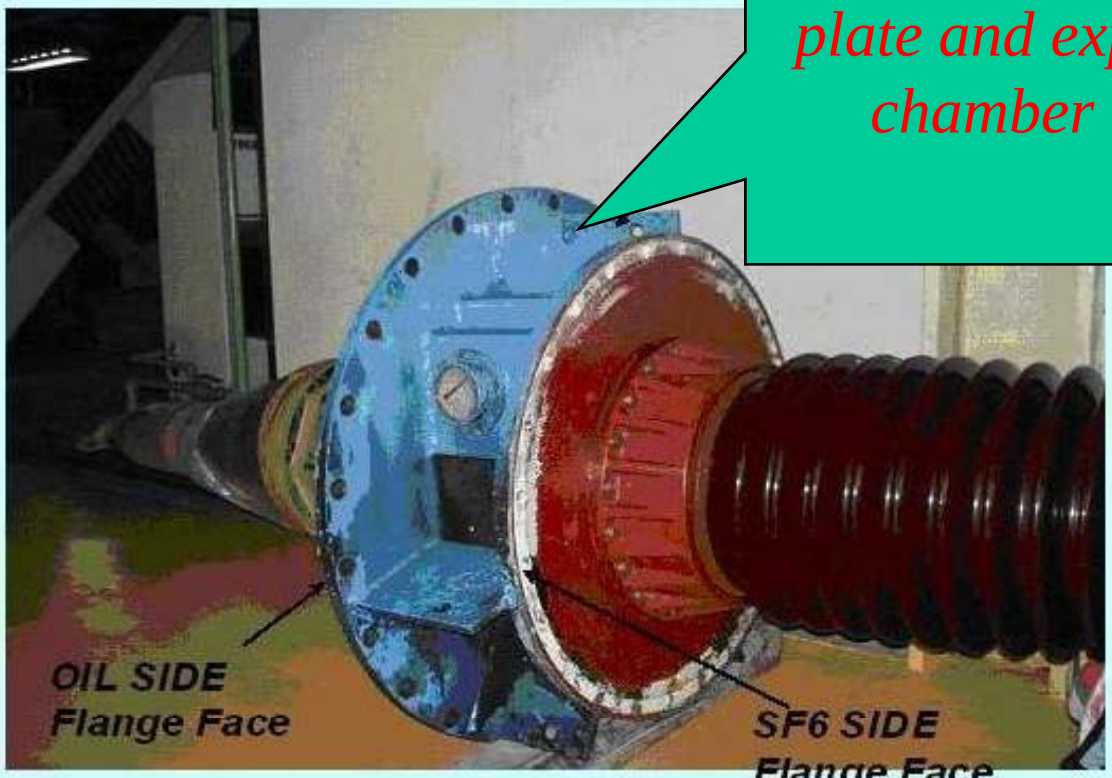
- After inspection on the startup transformer , a small corroded perforation was found on its phase B bushing.
- Water intruded into the bushing body via the small corroded perforation caused the bushing faulted .
- The bushing fault was initiated by internal corona phenomenon.
- Sudden instantaneous high oil pressure actuated pressure relief device and blew out the bushing hand hole , High temperature oil gas got ignited upon its contact with oxygen in the air.

Phase B bushing hand-hole was blown out



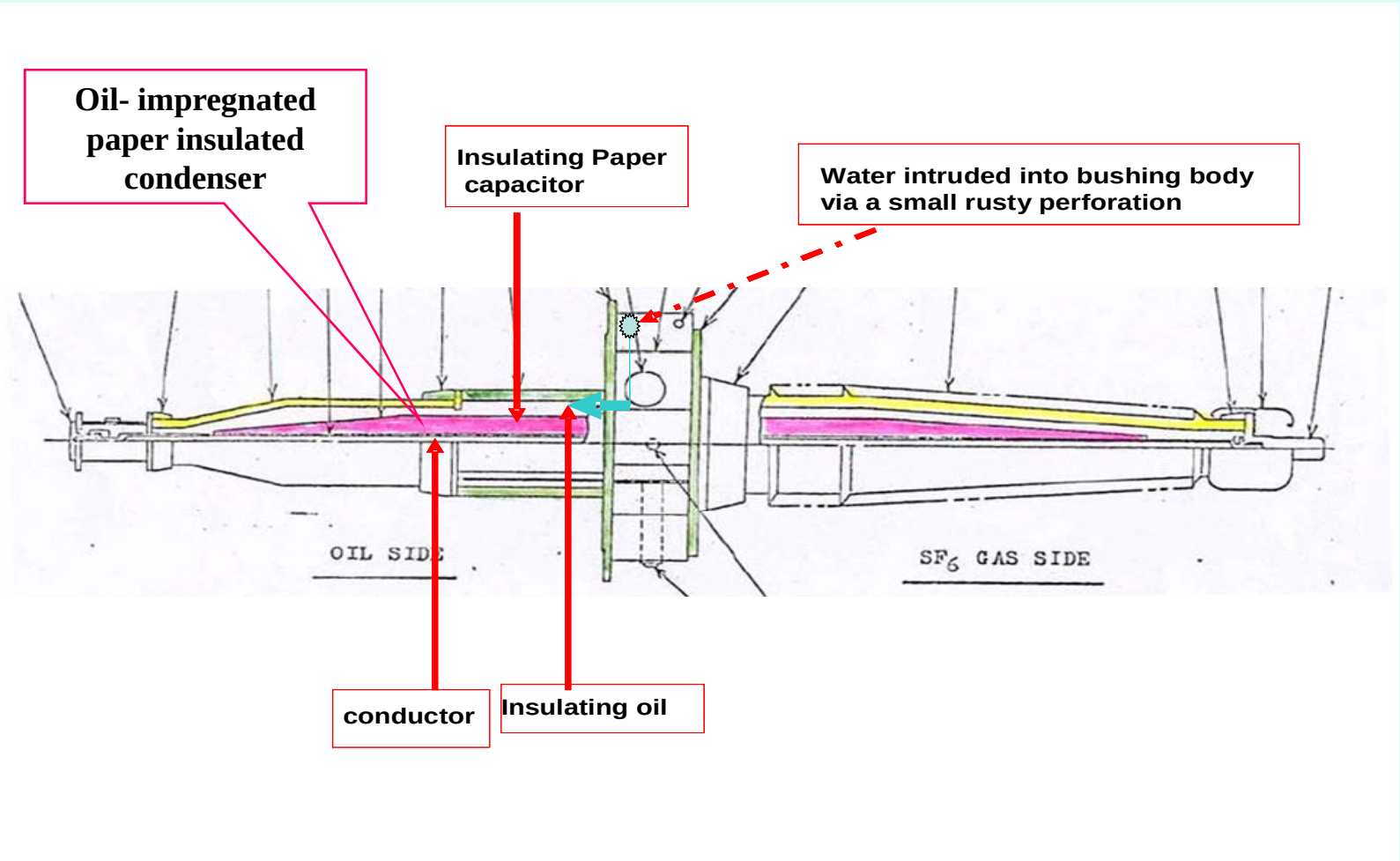
BUSHING

Corroded perforation close to the welding joint of lifting lug plate and expansion chamber body



Location of corroded perforation

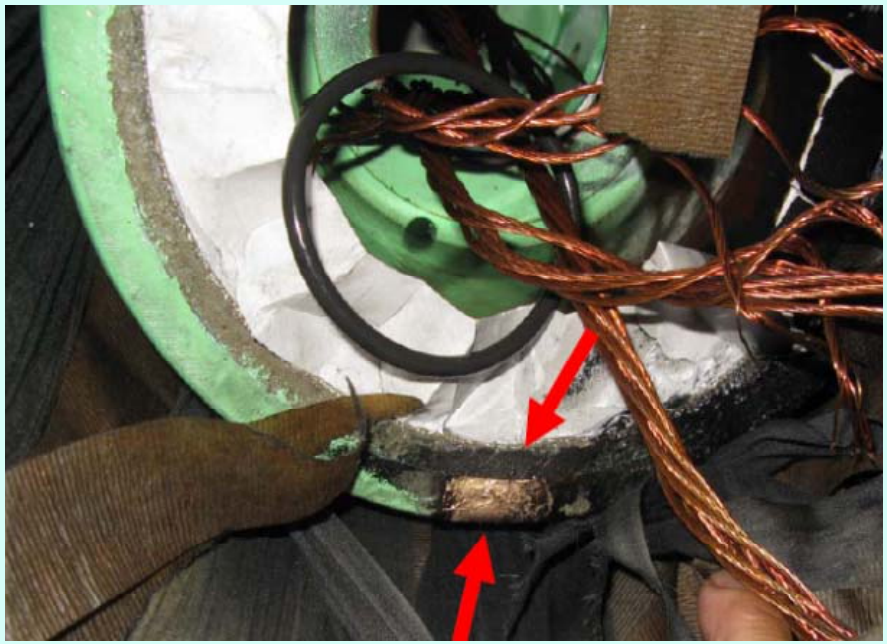
corroded perforation location


Oil- impregnated paper insulated condenser
Insulating Paper capacitor
Water intruded into bushing body via a small rusty perforation
OIL SIDE
SF6 GAS SIDE
conductor
Insulating oil

Flashover Spot (Bushing oil)

Flashover spot on capacitor paper layers

flashover spot (phase B bushing connection)



Flashover point

Corrective Actions

1. *Inspecting all the HV bushings of similar design to check if rusty corrosions existed.*
2. *Improving the drain path on the HV bushing expansion chamber structure to avoid accumulating rainwater .*
3. *A revised procedure has been worked out and V&V tested for measuring the power factor of the HV bushing properly.*
4. *Evaluating the feasibility to install Partial Discharge(PD) monitor or on-line power factor monitoring equipment.*

Thank You