

Steam Turbine Failure During Overspeed Test

Eskom Duvha Unit No. 4
9 February 2011

Republic of South Africa

Updated Presentation Rev 2

- 2 May 2011 expansion of the original presentation from 7 April 2011.
- Additional pictures received via e-mail showing 'missile' damage
- Three slides from Eskom presentation on power impact, photographs and explanation that no root cause analysis information will be released until completion of the investigation.

Severe damage to Unit No. 4 after failed overspeed test



Turbine Failure During Overspeed Testing

- Statutory turbine testing (later reported as an overspeed test) ended in severe mechanical damage
- Performed Wednesday night 9 February 2011
- The unit was not on load.
- Protection on the unit failed leading to rupture
- A fire broke out and it was rapidly brought under control.
- Technical review has been launched
- Outage estimated up to 18 months

Duvha Station

- 600 MW GEC Alstom Units
- Tandem Compound Four Casing Units
- 3,000 rpm
- Station came on line in November 1975
- Common turbine hall
- Five sister units undamaged and remained available for generation

News Release



Date:
10 February 2011

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Dear Stakeholders and Customers,

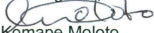
Mechanical damage to Duvha Unit 4

Eskom's leadership continuously monitors the performance of the power system and its risk profile. Eskom has committed to ensuring that there is a flow of information to all its stakeholders and customers on the state of the power system and the interventions proposed to ensure that the lights are kept on.

One of the units at Eskom's Duvha Power Station (Unit 4) was damaged last night whilst undergoing a statutory turbine test. The unit was not on load at the time and there were no injuries to personnel. The remaining five units are on full load and the national grid remains in "green status" i.e. Eskom is generating enough power to satisfy the demand in the national grid. Preliminary investigations point to substantial damage requiring extensive time to repair the unit and return it to service.

During testing of the turbine, the protection on the unit failed resulting in severe mechanical damage and the break out of a fire which was rapidly brought under control. Eskom has launched a technical review of the incident to establish the root cause of the unit failure and prevent similar incidents in future.

Eskom will continue to keep you informed of the electricity supply position and the need to protect the integrity of our electricity supply system in the interest of the country and all of our customers.

Kind regards,

Komape Moloto
Regional Engineering Manager
Eskom Distribution
Southern Region

Intact Unit from Generator End



Damage to Low Pressure (LP) Casings and Cross Over Piping



Severe outer casing rupture LP2



Fire damage at High Pressure (HP) Turbine



Damage at Generator (left) to Exciter (right) Coupling



Coupling Shaft thrown from unit



Shaft thrown from unit



Structural Damage



Damage to roof

(20 m above the turbine deck)



Duvha LSB Failure 2003

- Sister Unit No. 2 suffered a last stage blade (LSB) failure on 8 January 2003.
- Similar damage as seen on Unit No. 4 with a fire, ruptured shafts & components leaving the building
- Minimal visible damage to outside of LP casings



Eskom Update

- **On 8 April 2011 Eskom issued the ‘Quarterly Update: State of the Power System’**
- **The following three slides are from that document covering the Duvha incident.**
- **Source**
<http://www.eskom.co.za/content/PowerSystemUpdateWinter2011final.pdf>

Update on mechanical damage to Duvha Unit



- As we announced before 08h00 on 10 February, unit 4 of the Duvha power station was damaged during statutory turbine overspeed protection test. The damage is extensive and will take more than a year to repair
- No-one was injured, for which we are thankful
- Independent investigation into the cause of the incident is under way. The Duvha recovery team has the go-ahead from investigators to proceed with the first phase of returning the 600 MW unit to service
- Eskom has consistently declined to speculate about the findings of the investigation. Once complete, a statement will be released and shared with stakeholders
- Recovery time depends on the availability of spare components and their level of serviceability. The cost to repair and timing of repairs are still being established

Update on mechanical damage to Duvha Unit



Duvha Unit 4 failure will impact the system



Impact on available plant

- 575 MW less capacity is available on the power system
- This places increased pressure on performance of the rest of the fleet

Managing the reduction in available capacity

- The Duvha Unit 4 event is part of the overall plant unavailable due to forced outages
- Changes have been made to the planned maintenance schedule to accommodate Duvha Unit 4
- This means that the ideal level of maintenance cannot be done

Additional Pictures

- The following pictures were received in April 2011, after the initial batch, and continue to show the damage to the turbine generator set.
- The pictures also show extensive damage done to the plant by 'missiles' created by thrown machine components.





ALTERNATING CURRENT GENERATOR

DIRECT HYDROGEN COOLED ROTOR - WATER COOLED STATOR WINDING

KW	60,000	VOLTS	12,000	VOLTAGE RANGE	3:1	Hz	30
KVA	81,500	AMPS	17,400	STORED ENERGY CONST.	315	RPM	5000
PF	0.8	PH	3	CONNECTIONS	Y	RATED GAS PRESSURE	4500 PSI
STANDARD	IEEE	INSULATION CLASS	B	MAXIMUM INLET GAS			40°C
EXCITATION VOLTS			400	EXCITATION AMPS			1000
RATING	CONTINUOUS			FRAME REFERENCE	T6045-6720-2547		
SERIAL No.	E2079/01			DATE OF MANUFACTURE	1980		

Supplied by

GEC Turbine Generators Limited

Generator Division

Stafford England

MADE IN GREAT BRITAIN































The End

More to be learnt