

## MATTHEWS INTEGRITY HUB



HEAD OFFICE

### FAILURE BRIEFING

#### CATASTROPHIC FAILURE OF A STEAM DIFFUSER; VIBRATION FATIGUE

##### THE ARRANGEMENT

The photo shows the arrangement of a steam diffuser used in a power station steam line. It is located in the steam dump line from the low pressure stage of the steam turbine to the condenser duct. If the turbine trips for any reason a dump valve opens and exhausts steam at 30 bar down the dump line and into the condenser duct (which is normally under vacuum) via the diffuser.

##### THE FAILURE

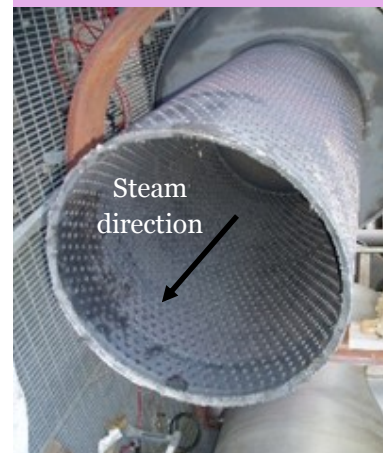
After one turbine trip the dump line was seen to be vibrating heavily where it entered the condenser, suggesting that the diffuser was no longer diffusing the steam. The plant was shut down and the diffuser accessed for inspection. The flat end the diffuser was found to be completely broken off in the circumferential plane (see photo).

##### THE CONSEQUENCES

There were no immediate injuries or safety risks caused by the failure. If the plant had continued to be used then the increased vibration caused by dump steam impinging on the condenser steam duct would have increased the risk of further failure and steam leaks. The cost of the plant shutdown was about £100.000 in lost generation revenue, plus repair costs.

##### WHAT WAS THE CAUSE?

This is a common failure mode. What do you think caused it? See next page for : **Failure Diagnosis and Lessons learned**



Diffuser with end missing



Diffuser end



Fracture surface

# STEAM DIFFUSER FAILURE LESSONS LEARNED

## MATTHEWS INTEGRITY HUB

### FAILURE BRIEFINGS

We think it is important in the asset integrity industry to **SHARE INFORMATION** on equipment accidents and failures. This is the main way in which people learn how failures can be prevented and that the same mistakes do not happen again and again.

Most causes of failure are well known and can be prevented by learning from things that have happened in the past

## WE INVITE YOU TO PARTICIPATE

The more failure briefings we can show on these pages the better the chance of failures not repeating themselves unnecessarily. If you want to pass on details of failures you've experienced we will be pleased to edit them into our failure briefing format so they can be of greatest benefit to others in the plant integrity community.



**HEAD OFFICE**

### THE DIAGNOSIS

The photo shows the fracture face as a classic vibration fatigue fracture. The crack starts as a flat surface showing 'beach marks' and then ends as a ductile 'tearing' failure showing shear lips. Once the failure occurred then it propagated instantly around the circumference giving the neat circumferential fracture.

The vibration was the result of the dump steam impinging on the flat end of the diffuser during repeated steam dumping. It was made worse by general mechanical vibration of the condenser steam duct in normal service.

### LESSONS LEARNED How not to let it happen again.

This is a simple but very common type of failure case. It turned out that vibration of the dump line and condenser steam had been



noticed during both normal operation and dump conditions for some time. It was reported by operators that you could hear and see heavy vibration when walking past the duct. No-one took the initiative to measure the vibration (using a simple hand-held meter) or solve the problem, until the failure occurred.

### BARRIERS TO GET IN YOUR WAY

It can be difficult to get a plant shut down if pressure or structural parts of it are just showing vibration. Revenue will be lost so people assume everything will be OK. That's why many mechanical fatigue failures happen.

**Matthews Integrity Hub: HEAD OFFICE** is **OPEN EVERY DAY....0730-2200 Monday-Sunday...**That's correct, all week, including holidays.

If we miss your call, leave a message and we will call you back just as soon as we pick it up. Sorry, there's no automated messages, call queueing, voice recognition robots or garbled music. Try it and see.