RILEY PROGRAMS AND SERVICES TO IMPROVE AVAILABILITY

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INTRODUCTION

Manufacturers and utilities must work together to reduce the duration of outages and to increase the duration between outages. Improving boiler availability has been a topic of discussion at forums such as this for many years. Now it is time to move beyond discussing how availability might be improved. Today I will tell you about Riley's Plant Improvement Division (PID) programs and services which have been designed specifically to improve boiler availability.

Riley-PID has many services which address availability. The Division's purpose is to improve power plant equipment and operations and, by extension, to improve availability. I will present four of our approaches: the Boiler Availability Improvement Program, the Team Inspection Service, the Annual Maintenance Agreement, and the Service Advisory Program. All of these programs either reduce the duration of outages or increase the duration between outages.

BOILER AVAILABILITY IMPROVEMENT PROGRAM

In 1978, Riley's Plant Improvement Division set up a formal Boiler Availability Improvement Program (BAIP), which was outlined in a paper presented to this forum that year.[1] Since then, Riley-PID has offered various elements of the BAIP to many of its utility customers. Extremely popular during the past two years has been the Team Inspection Service, explained in more detail later.

Essentially the BAIP is a performance and mechanical analysis of the conditions and operations of a boiler.

The basic objectives of the BAIP are:

- To identify the root causes of operational problems
- To develop corrections to these problems
- To work with a utility to improve the availability of an existing boiler

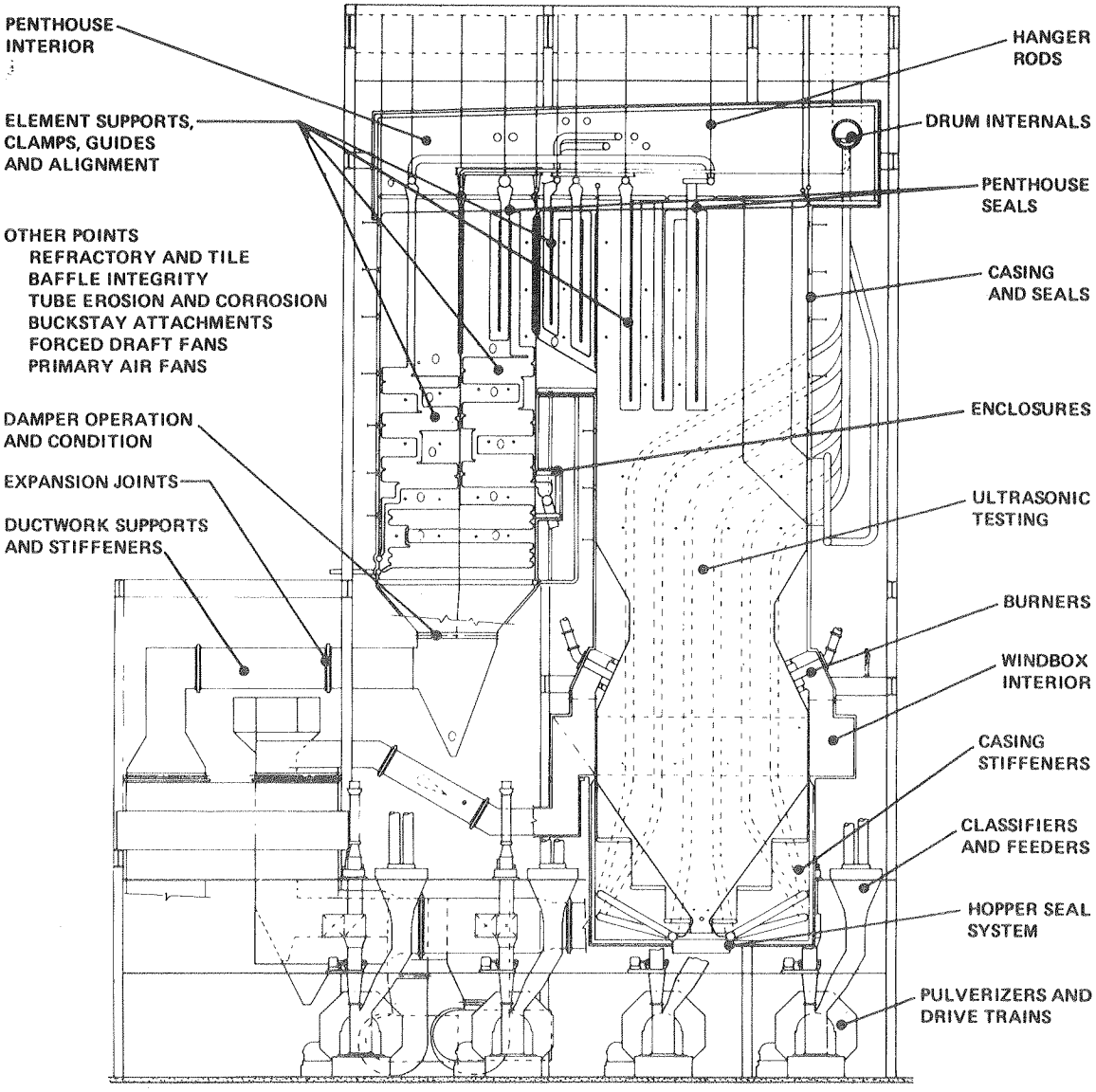
PENTHOUSE INTERIOR
ELEMENT SUPPORTS, CLAMPS, GUIDES AND ALIGNMENT
OTHER POINTS
REFRACTORY AND TILE
BAFFLE INTEGRITY
TUBE EROSION AND CORROSION
BUCKSTAY ATTACHMENTS
FORCED DRAFT FANS
PRIMARY AIR FANS
DAMPER OPERATION AND CONDITION
EXPANSION JOINTS
DUCTWORK SUPPORTS AND STIFFENERS
HANGER RODS
DRUM INTERNALS
PENTHOUSE SEALS
CASING AND SEALS
ENCLOSURES
ULTRASONIC TESTING
BURNERS
WINDBOX INTERIOR
CASING STIFFENERS
CLASSIFIERS AND FEEDERS
HOPPER SEAL SYSTEM
PULVERIZERS AND DRIVE TRAINS

Figure 1

Figure 1 shows many of the areas which various manufacturers have determined require detailed inspection and reports. The items indicated may be expanded depending upon the unit history. Riley-PID recommendations might lead to any or all of the following:

- Upgrading or restoring the physical condition of the boiler
- Assuring 100% performance of preventive maintenance
- Modifying or eliminating equipment items with high maintenance requirements and low availability
- Developing improved operating procedures

In short, the BAIP is carried out over a contractual period — usually one year. Within that time frame, the program progresses through four phases.

Phase I, Program Development — Both Riley-PID and utility engineering and plant representatives work together to design the program. The team relationship continues throughout the program. During this phase, the operational history of the unit is reviewed.

Phase II, Unit Performance Analysis — A data base is developed to use as a bench mark of the unit's performance in the program recommendation stage. During this phase, the plant is visited and the total operation observed. Accumulated actual data and visual observations will be compared with the original design data and comparisons will be made.

Phase III, Team Inspection — An in-depth inspection of all equipment and an analysis of materials is done using boiler design, fuel burning, quality control, and boiler construction expertise, as required.

Phase IV, Analysis and Reporting — A preliminary report documenting findings immediately follows the inspection. A complete report dossier is prepared and presented to the customer upon completion of various tests and analyses.

Utility representatives remain active in the program throughout its duration. They actually undergo both informal and formal training, if necessary. As a result, after the program is completed, the utility's participating representatives will be in a better position, in the future, to prevent unplanned outages themselves.

The full-service BAIP has been very successful at several of our utility customers' units including one in a large North Carolina utility and another in Kentucky. Our customers have found that the service pays for itself immediately if only one unplanned outage is eliminated.

For example, Riley-PID has been able to pinpoint a variety of corrective actions for its customers. The service can point to both long term cures to increase utilization of the unit and extend the duration between outages, as well as to ways to prevent the occurrence of unplanned outages. Examples are summarized below.

1. *Inspect, ultrasonically and visually, a band of waterwall tubes at the burner elevation for thinning and bulges.* There was an indication of localized overheating of the tubes caused by flame impingement.
2. *Retain a foundation consultant to study and make recommendations on a foundation problem in a ball tube mill. After correction of that problem, alignments of the mill and condition of the bearings need to be checked.* Many of the balls in the charges were too large; they needed to be brought into specification.
3. *Perform repair work to patch broken welds and to prevent more welds from breaking.* Welds attaching the structural steel for the windbox to the furnace wall tubes were breaking. This allowed a gap to form between the burner throat tile and the castable refractory on the throat tubes. The gap allowed radiant heat into the cavity causing deterioration of the structural members and the attachment welds.

4. *Replace the seal attachment bracket or fin and inspect the area of the deterioration during future outages.* The seal plate bracket or fin on the lower waterwall headers had deteriorated allowing outside air to be drawn into the boiler.

5. *Perform a complete review of the inlet and outlet piping hanger design to determine why the hangers are not performing to original design specifications.* Immediate short-term and long-term fixes for the primary heater support problems were proposed.

TEAM INSPECTION SERVICE

The Team Inspection Service (TIS) is a customized version of the BAIP which solves either a basic boiler problem or assesses the feasibility of a utility's future plans for a unit. The objective of the TIS is to improve overall unit availability by reducing the duration of unplanned outages and increasing the duration between outages.

In short, the TIS is an in-depth inspection by up to six technical experts of all parts of a customer's unit, both internal and external. The TIS helps plant managers to answer important questions such as whether 1) to upgrade or convert an existing boiler, 2) to bring an old boiler back into service, 3) to buy a new boiler, or 4) to do nothing other than utilize an existing boiler for its remaining useful life. But, primarily, the TIS is flexible in scope and requires no long-term commitment on the utility's part. The utility identifies the problems, and both the team and the inspection are organized to concentrate on these problems.

The TIS is a four-part program and includes:

1. Unit inspection and evaluation
2. Preliminary findings — both oral and written at the time of the plant visit
3. Materials testing — off-site
4. Final report findings and recommendations

The utility writes the entire scope of the Team Inspection Service, which could include:

- Inspections to determine if a boiler which has been run below rating for years could now be brought up to its original design specifications.
- In-depth inspection and study to determine the feasibility of upgrading the temperature, pressure and/or capacity of a unit.
- Determinations of the work required to permanently repair long-standing boiler or fuel burning problems to which in-plant personnel were able to apply only temporary fixes.
- Tests to establish overall unit efficiency and establish requirements for improvement.

The TIS includes the services of boiler design, fuel burning design, and field service engineers, as well as metallurgists and construction specialists. An inspection may require the services of two or more skilled Riley engineers, depending on the scope of the investigation.

After the inspection and evaluation of the test data, the inspection team initiates a review with the Riley Engineering Division and prepares its report. This formal report will present findings and recommend corrective actions. It may include suggestions for operator training or for changes in operating and maintenance procedures, if appropriate.

Riley-PID has found that the more narrowly defined TIS is currently meeting the needs of many of our utility customers throughout North America.

ANNUAL MAINTENANCE AGREEMENT

Many utilities contract with Riley-PID for annual maintenance because it is cost effective and reduces the duration of outages by having maintenance experts on call. Upon investigation, utilities throughout the country have found annual maintenance agreements very attractive. Many of their basic advantages are outlined below.

- Fast response to emergency needs by an on-call boiler maintenance expert.
- No delay caused by negotiating terms, conditions, payrates, and margins.
- Knowledge of local labor and union rules.
- Familiarity with plant, personnel and operations.
- Ability to work multiple shifts and/or overtime for extended periods, if necessary.
- Scope of work can easily be extended or modified.

In addition to the basic advantages of having a maintenance agreement, there are many specific advantages Riley offers utilities.

- Riley has over 70 years experience as a boiler designer and manufacturer.
- Our Construction Division has experience in all areas of boiler construction and modification.
- Many of the miscellaneous parts required can be obtained readily through Riley's Parts Department. Also, from past experience, we are familiar with where a part can be made in a vendor's shop, quickly and correctly.
- For any modification or repair we utilize Riley Engineering and Construction Standards that have been used and accepted by the industry.
- A Riley Project Manager will be assigned to coordinate all field work, engineering, material procurement, and commercial activities.
- The full use of Riley manpower, i.e., expeditors, buyers, and technical expertise.
- Cost of supervision is reduced when Riley labor is used.
- Due to Riley familiarity with local unions, concessions as to work assignments, overtime and fringes may be possible and any such savings are passed on to the utility.

Riley-PID boiler maintenance experts are called in to do a variety of tasks for a utility, including:

- Repair leaks in pressure parts
- Install large replacement parts
- Overhaul mills and fuel burning equipment
- Repair fans and other auxiliary equipment
- Replace dampers, expansion joints and other ducts

Utilities throughout the country, both large and small, have found that a Riley-PID Annual Maintenance Agreement suits their needs as one more protection against unnecessarily long outages.

SERVICE ADVISORY PROGRAM

Riley's Service Advisory Program provides a method by which significant information affecting boiler availability is distributed to our customers and to Riley technical staff. A Service Advisory is similar to the publications that turbine manufacturers use to warn users of generic design characteristics which could

present problems. The purpose of the Service Advisory is to alert recipients to the latest developments and recommendations concerning equipment operation and maintenance. The program provides utilities with summaries of current knowledge of operating experience that may be helpful in maintaining equipment efficiency, reliability, and/or safety as well as reducing the duration of outages and increasing the duration between outages.

The distributed information is generated by a variety of sources both inside and outside the company. Generally, however, the recommendations come from Riley technical personnel. A procedure has been developed which assures that the operating and maintenance safeguards and suggestions furnished include all the information useful for utilities to assess adequately how the recommendations relate specifically to their equipment.

Included would be the reasons for the change, addition or deletion, such as safety, efficiency or economics; and the change, addition, or deletion necessary to produce the expected benefit(s).

Over the years, the Service Advisory has addressed a variety of operational and maintenance suggestions which have improved boiler availability for our customers while addressing both personnel and equipment safety. For example:

1. *Superheater and Reheater Protection — Use of Furnace Thermoprobe.*
   Riley advised customers to always use furnace thermoprobes during startup to protect superheater and reheater elements from damage caused by overheating. The generic design characteristics of the equipment required the issuance of supplemental operating precautions to help extend the life of the equipment and to protect against unplanned outages.

2. *Air Heater Pluggage — Furnace Observations.*
   Riley alerted customers to the personnel hazard and operating inefficiencies which exist when furnace pressure fluctuations occur due to air heater pluggage. Utilizing recommended precautions, operators should periodically conduct furnace inspections when operating any unit. These inspections determine the level of slag formations and flame conditions which may lead ultimately to unplanned outages of longer duration.

The dwindling supplies of traditional energy sources have resulted in users of coal turning more to coals having characteristics which are more hazardous than those used in the past. In recognition of that and of the generic design characteristics of pulverizers, Riley issued the following two Service Advisories to increase boiler availability.

3. *Pulverizer Operations/Safeguards*
   Riley recommended the use of safeguards in the operation of pulverizers to prevent pulverized coal explosions. A team of Riley experts investigated the problem and developed improved operation and maintenance procedures for fuel preparation and handling equipment which were subsequently issued to users of the system.

4. *Pulverizer — Recommendations for Inerting*
   Riley informed customers of the availability of inerting media, methodologies and systems which should be considered by the users of pulverizers to decrease the risk associated with burning coals of higher and higher volatility.

SUMMARY

The four Riley Stoker programs described in this paper — the Boiler Availability Improvement Program, Team Inspection Service, Annual Maintenance Agreement, and Service Advisory Program — have proven to be effective tools to assist customers in their efforts to improve plant operations. Working with utilities, we will continue to develop new programs and services that are responsive to industry needs for improving reliability and availability.

REFERENCE

1. Heritage, K. J. "Improving Boiler Availability." Presented to the Committee on Power Generation, Association of Edison Illuminating Companies, Atlanta, GA, September 13, 1978.