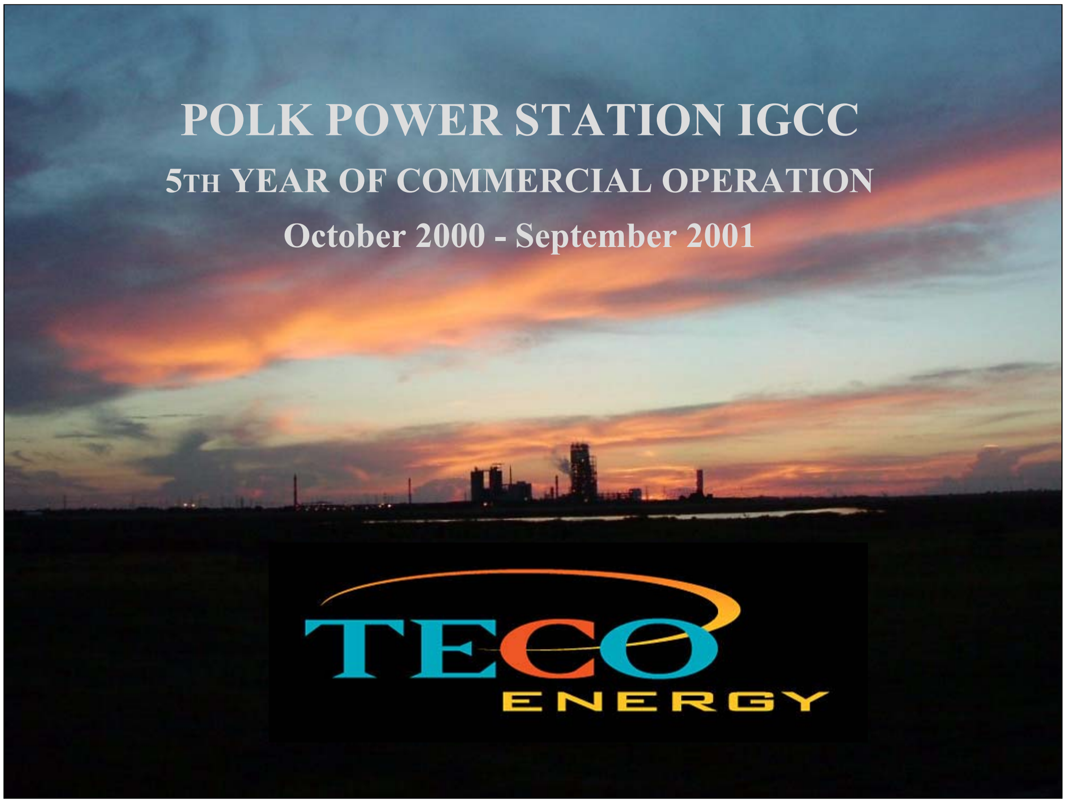

POLK POWER STATION - 5TH COMMERCIAL YEAR OF OPERATION

by

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and

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PRESENTED AT

2001 GASIFICATION TECHNOLOGIES CONFERENCE

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Polk Power Station recently completed its 5th year of commercial operation.

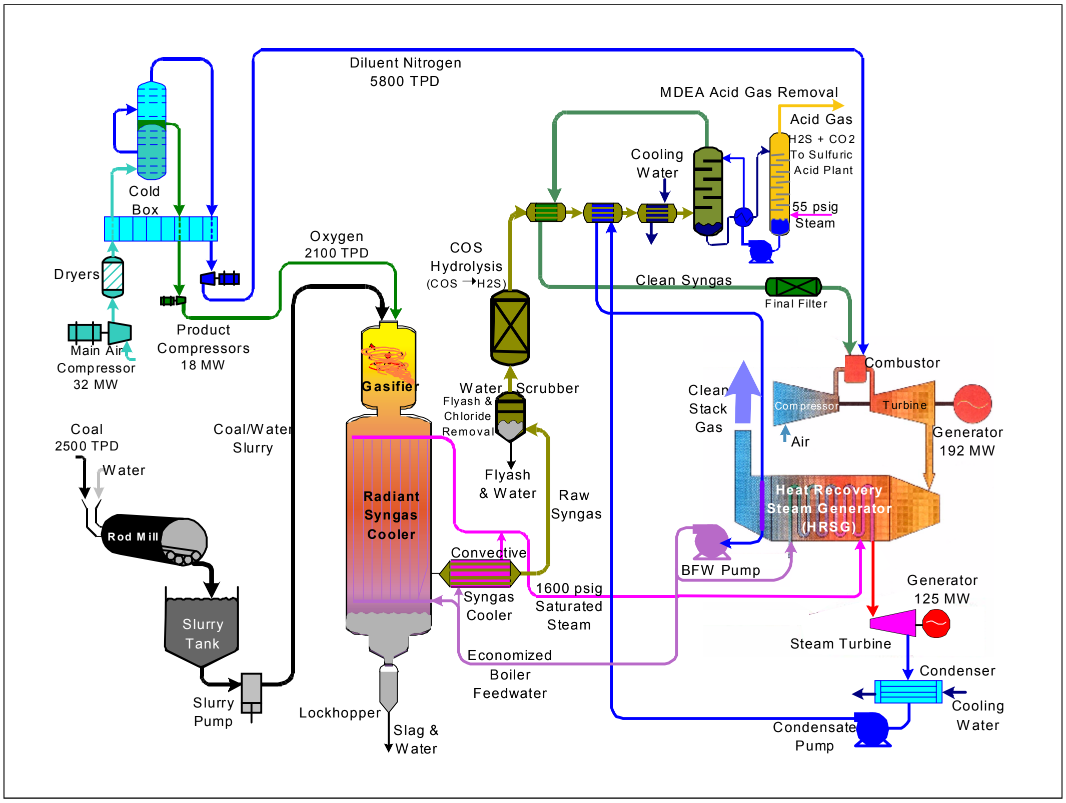
Today's presentation will contain:

•Polk's operating statistics prescribed by the GTC's recent guidelines,

•Summary of the major outage causes encountered in year 5,

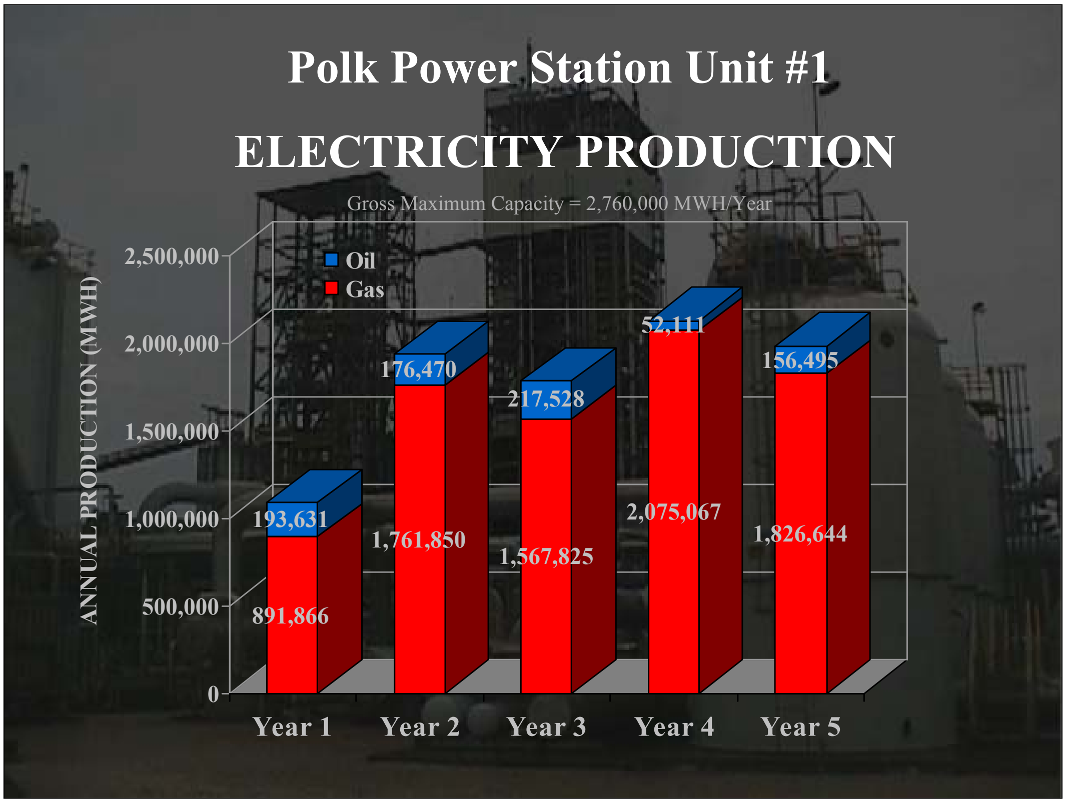
•Discussion of the two major challenges currently facing Polk:

- •Potential requirement to install an SCR and its implications
- •Cost effective slag disposal and elimination of excess slag production.



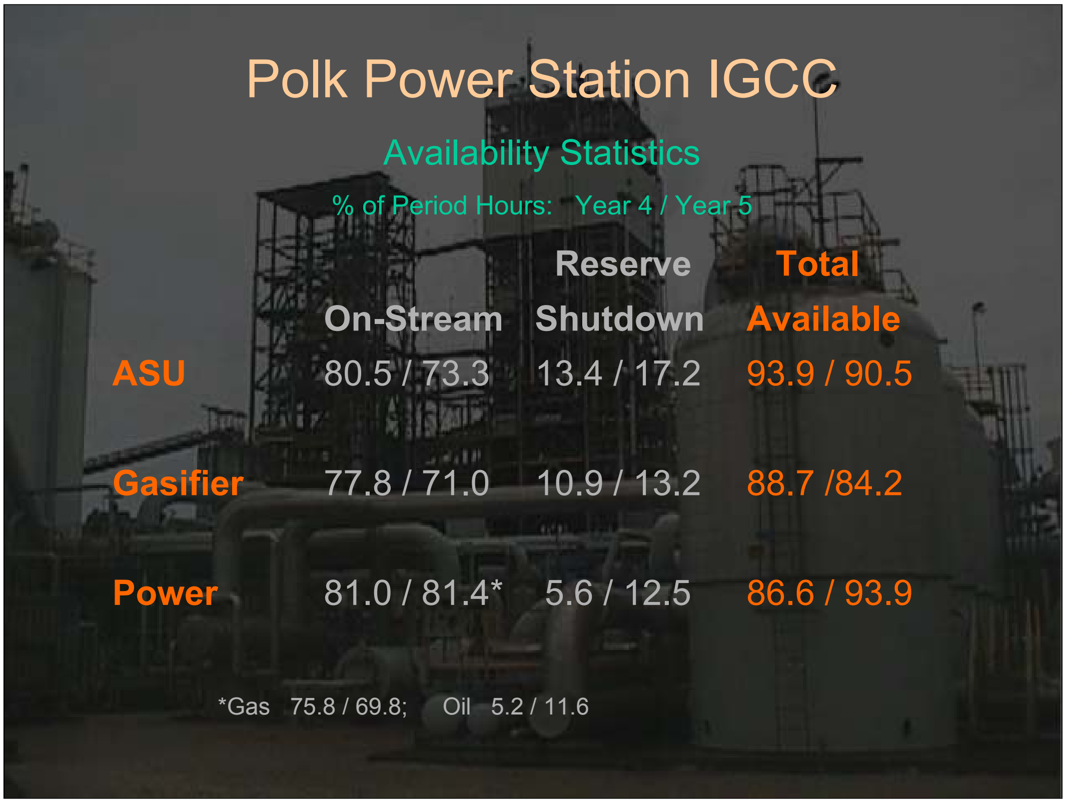
This is a schematic flow diagram of the Polk IGCC system. A description of the process can be found in Tampa Electric's 1999 Gasification Technologies Conference paper.

This presentation will cover reliability statistics. It is important to recognize the extent of the redundancy provided in the configuration to put these statistics into proper perspective. Polk is essentially a single train facility with very little useful redundancy. We do have 5 days of coal storage on-site, 2-60% rod mill systems and 6 hours of slurry storage. Our 2 convective syngas cooler and syngas scrubber systems are more of a reliability detriment than asset. It is also important to note that, unlike most other Texaco coal gasification systems, we have only 1 slurry feed pump and no oxygen storage to accommodate brief slurry feed or oxygen supply interruptions which we encounter several times per year.



This is an overview of Polk's five years of commercial operation. Year 4 was our best to date, with a gasifier capacity factor of 75%. Last year's gasifier capacity factor was only 66%, but production from distillate fuel brought the overall capacity factor up to 71.8%.

The individual major subsystem statistics on the next slide are more informative.

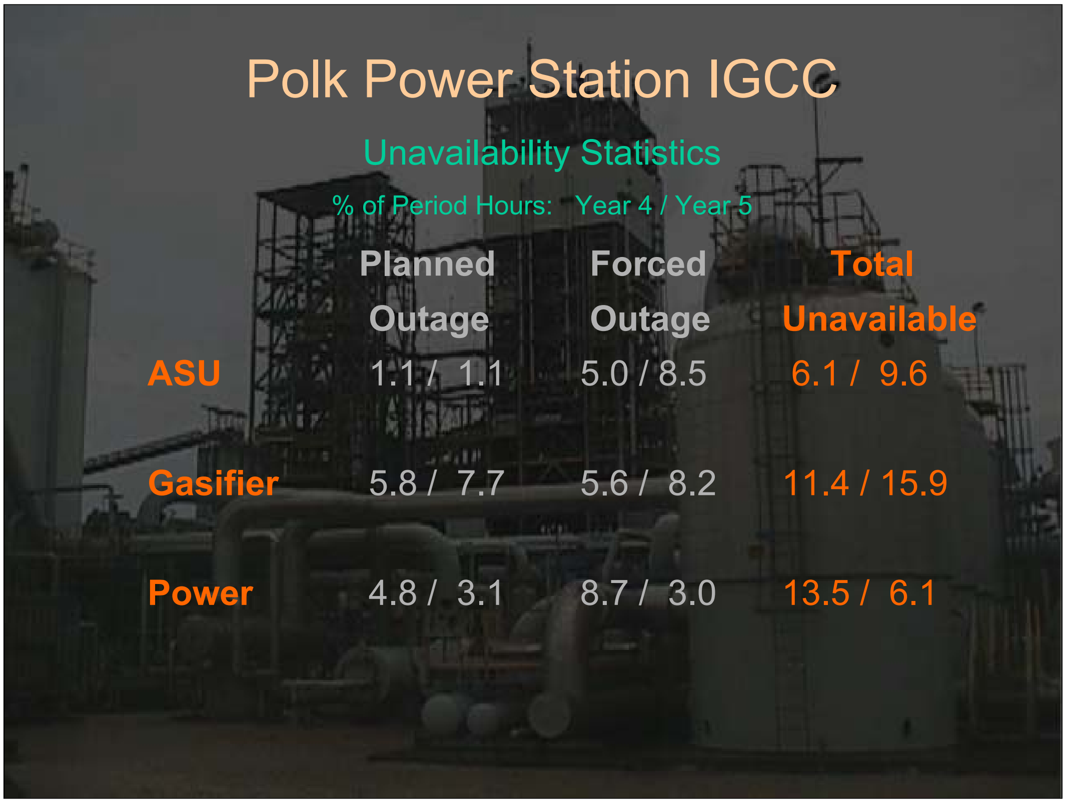


The term "Reserve Shutdown" is equivalent to the GTC's category "Product Not Needed". For the ASU and Power Block, this is straightforward. For the Gasification Plant, this reflects the percentage of the time when the gasifier was intentionally not operated for economic reasons, or when either the power block or the oxygen plant were unavailable.

The oxygen plant's availability was uncharacteristically low in both years 4 and 5. The major problem in year 4 was a distillation column leak discussed at last year's conference. The year 5 problems will be discussed later today.

The gasifier's 88.4% availability was excellent in year 4. Year 5's 84.2% availability was very acceptable, although we know we can improve.

86.6% availability for the power block in year 4 is relatively low for this system and reflects the distillate fuel problems discussed at last year's conference. Year 5's availability of 94.4% is much improved, and more in line with expectations and requirements. In fact, it is really the combined cycle's availability which enables Polk to meet one of its key objectives: high availability during periods of peak demand. Because of the combined cycle's improved performance, we achieved on-peak availability of 97.2% this year, almost 10 percentage points above our goal.



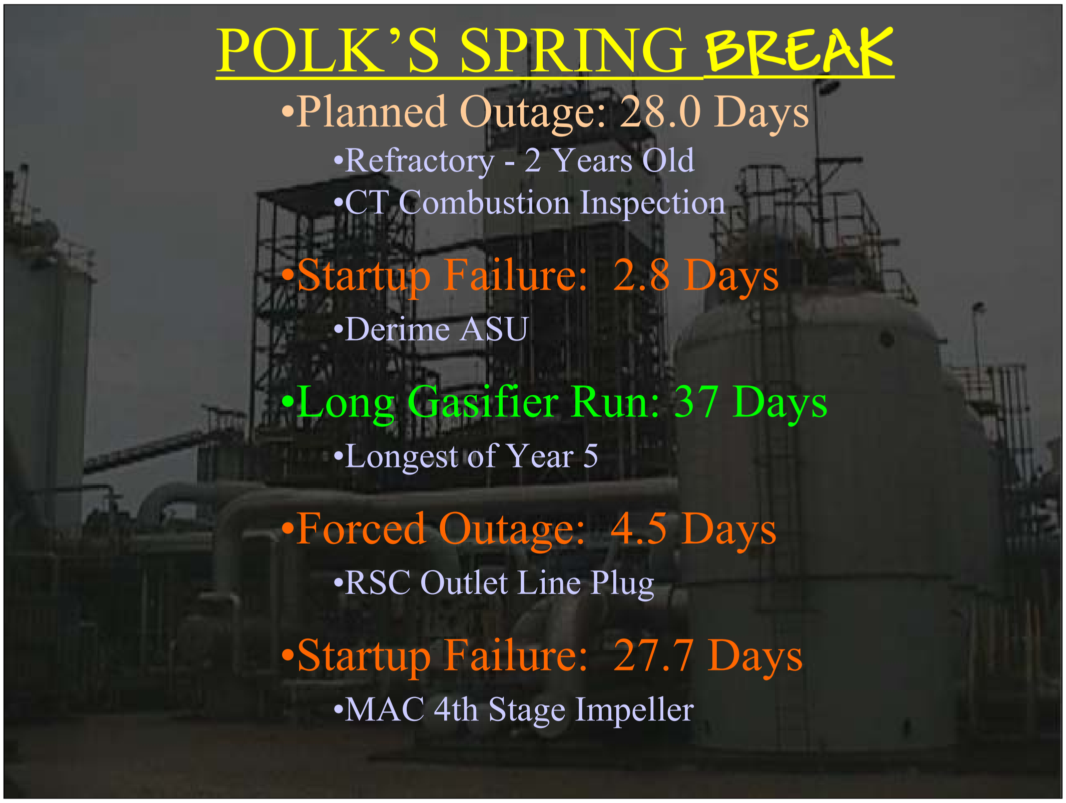
Unavailability, shown here, is merely the complement of availability from the previous slide. This slide differentiates between planned and forced outages.

There is relatively little oxygen plant planned outage work that can't be accomplished in 4 or 5 days of concentrated effort, so the ASU's planned outage time is relatively limited.

The gasifier's longer planned outage in year 5 compared to year 4 reflects the gasifier refractory liner replacement in year 5. Only minor refractory repairs, tie-ins, and routine inspections were done in the year 4 planned outages.

Conversely, the power block's longer planned outage in year 4 compared to year 5 reflects the hot gas path inspection in year 4 which took longer than the combustion hardware inspection in year 5.

Next, we'll discuss some of the details of Polk's unavailability in year 5. The first quarter of Polk's year 5, which was the last quarter of 2000, was exceptionally good with a gasifier on-stream factor of over 92%. The next quarter, the first quarter of 2001, was only average with a gasifier on-stream factor of 70%.

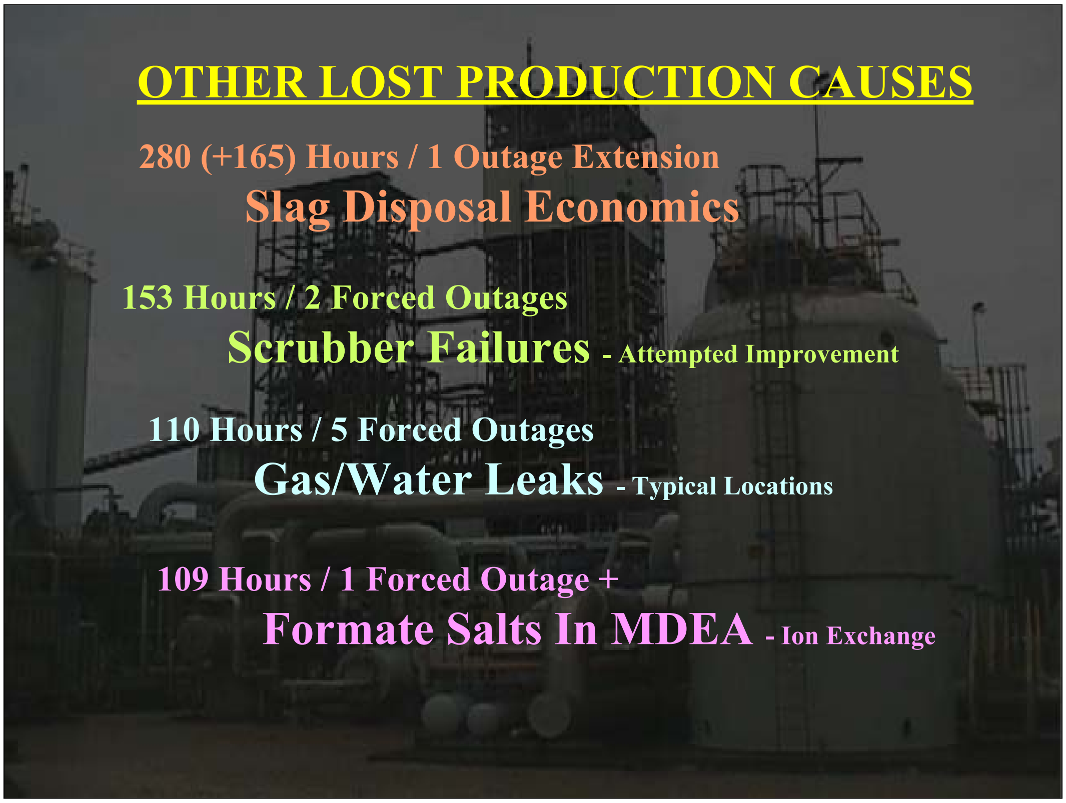


The spring quarter of 2001 was very troublesome as shown on this slide. The quarter began with the annual planned outage. One very positive note: the gasifier refractory had been in service for 2 years and it still had some remaining life. But there wasn't quite enough to be sure we would make it through the summer peak, so we replaced it. There were no unpleasant surprises from the combustion turbine's combustion hardware inspection.

When we were restarting the Oxygen plant at the end of the planned outage, a control system card failed, causing the air dryer to miss part of a regeneration cycle. This could have formed some ice in the main exchanger, so we elected to take the three days to derime (deice) the plant rather than risk having problems during the summer peak season.

We then had a very nice 37 day run, the longest of Polk's 5th commercial year. The run ended in a forced outage due to pluggage of one of the lines between the Radiant and Convective syngas coolers. The cause was a repair procedure that we tried during the planned outage which turned out to be unsuccessful.

As we were returning from the outage, we restarted the main air compressor. It idled normally for nine minutes, but as we loaded the machine, we observed extremely high vibration on its 4th stage. Cracks had developed in the impeller's brazed joints. It required 28 days to weld-repair the impeller and return the machine to service.



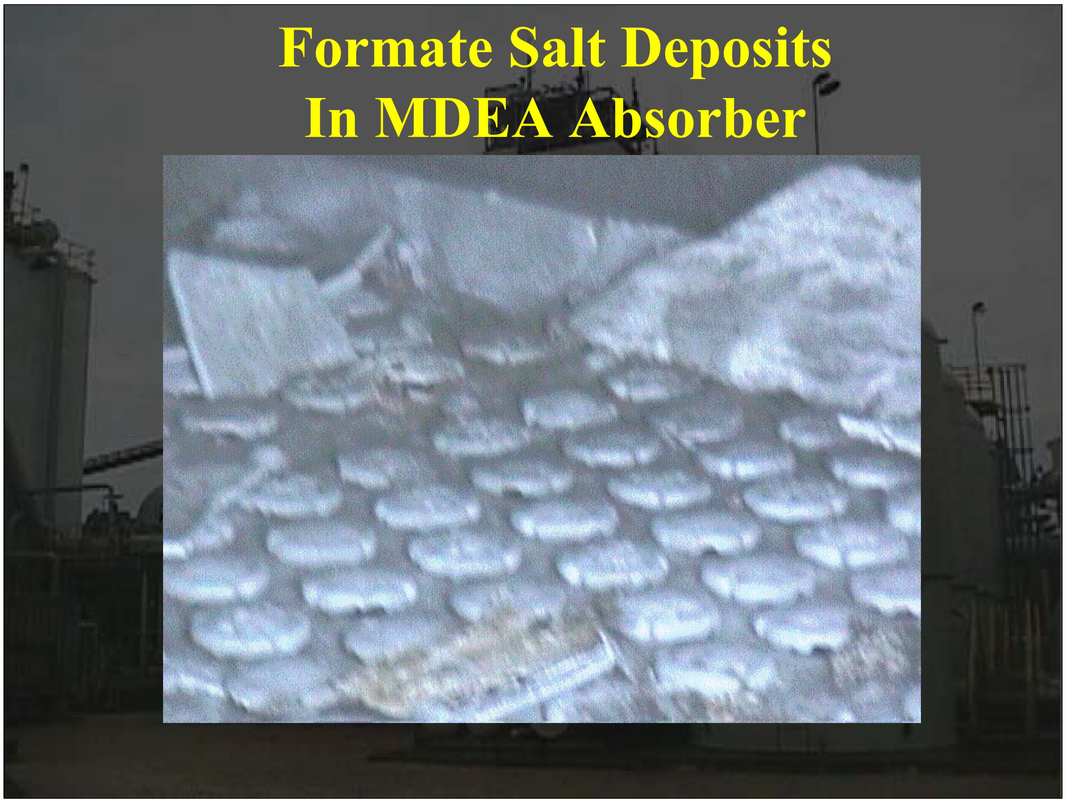
Other leading causes of lost gasifier production are shown here.

An 18 day gasifier outage this fall provided some temporary relief from high slag disposal costs while we made plant modifications to enable us to produce marketable slag. The slag issue will be discussed in more detail later. We also took this opportunity to repair some leaking seals in the radiant syngas cooler and perform other miscellaneous non-critical maintenance.

2 forced gasifier outages totaling over 6 days plus considerable additional O&M expense resulted from an unsuccessful process improvement attempt. The syngas scrubber environment is extremely erosive and corrosive, and its maintenance costs $¼ million each year. We observed a phenomena which suggested we might be able to save a significant fraction of this, so we tried it very successfully for 2 months on one scrubber. However, when we tried it on the second scrubber, it failed miserably.

We suffered 5 forced outages due to leaks in the raw gas and black water piping. We were able to repair 3 of them inside the 8 hour hot restart window, but 2 required longer. We could have eliminated at least some of them with better planning or preventative maintenance.

COS hydrolysis catalysts generate formic acid which produces non-regenerable heat stable salts in the acid gas removal solvent, MDEA. We had routinely utilized the services of Union Carbide to regenerate the solvent, but in this case, we waited too long. The salts plated out on the absorber trays as shown in the next slide and in downstream equipment. We added an ion exchange system in July which solved this problem.



Heat stable salts from the reaction of formic acid produced by the COS hydrolysis catalyst with the acid gas removal solvent MDEA reached the saturation level in the circulating solvent. The salts deposited on the valve trays of the acid gas absorber shown here. Some of the salty mist also carried over from the absorber and plugged downstream equipment.

A new ion exchange system installed in July 2001 regenerates the salts as they are formed. The problem has not recurred since.

It would be easy enough to blame all of the outages identified in the previous slides on process problems or equipment failures, and certainly they were contributing factors. However, root cause analyses of the failures reveal that Polk's IGCC technology need not be so costly. We could have eliminated or mitigated the losses in most cases.

The syngas and black water leaks occurred in places we should have known would be problematic. We took some calculated risks to reduce O&M costs which resulted in the plugged RSC outlet line and the syngas scrubber problems. Even in the case of the MAC 4th stage impeller failure, we had observed higher than normal vibration there for some time and planned to inspect it thoroughly during the spring 2001 outage, but we deferred this inspection due to budget and manpower constraints. The MDEA system plugging was much more costly than it would have been had we not been trying to reduce contract costs for solvent regeneration. And while an instrument failure certainly did cause the ASU dryers to miss a regeneration cycle, improved vigilance could have detected it earlier and eliminated the need to derime.

So, while IGCC is certainly a relatively complex and challenging technology, we are continuing down a path to improvement. We will learn from our mistakes, and through conferences such as this, we hope others will also.

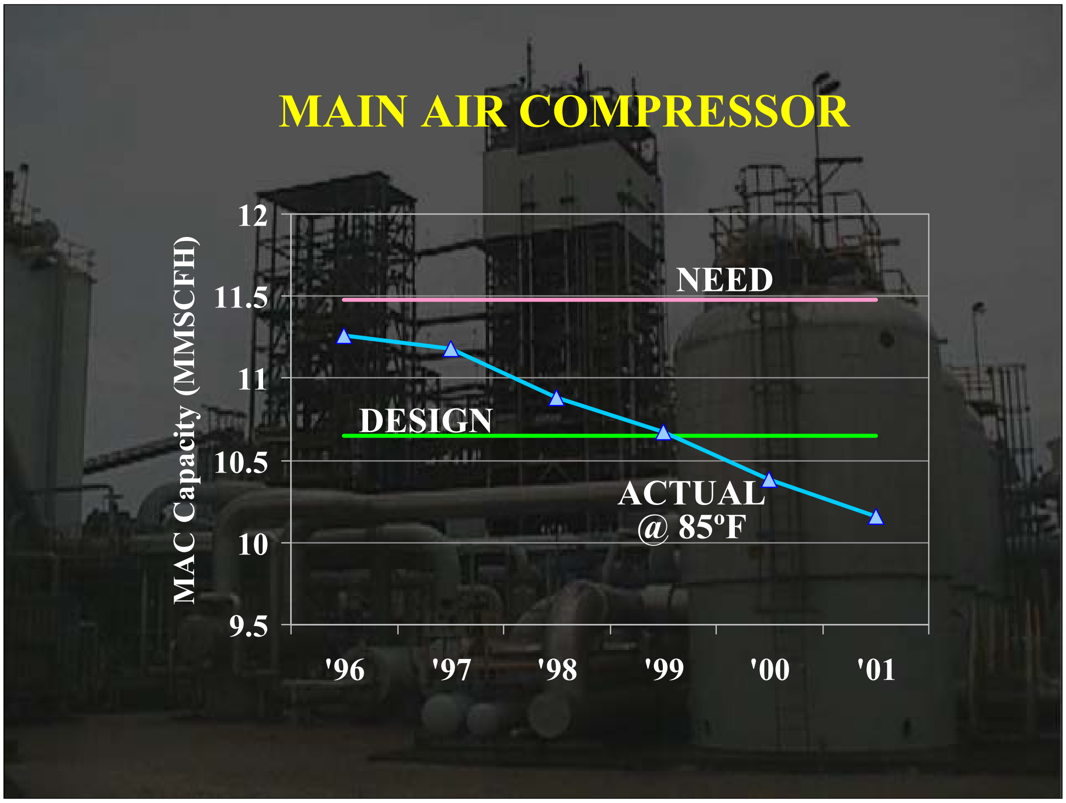
The last topics of today's presentation are Polk's current most pressing issues, slag disposal and the NOx best available control technology (BACT) analysis which could lead to the very expensive installation of a selective catalytic reduction (SCR) system.

Slag is the noncombustible mineral matter contained in coal plus any of the coal's carbon which was not converted to syngas in the gasification process. In previous papers at this conference, we have discussed the fact that there is approximately twice as much unconverted carbon from Polk's gasifier as initially expected. This unconverted carbon makes Polk's slag unsuitable for all known applications unless it is further processed.

We have doubled the size of the fines handling system and installed additional slag handling equipment to try to deal with with the unconverted carbon which is contained in the smaller slag particles (the fines). By reducing plant load and modifying our slag handling equipment, we produced 2000 tons of slag last summer that was beneficially reused by the cement industry at lower cost to us than Class I landfill disposal. However, this slag still did not consistently meet specifications.

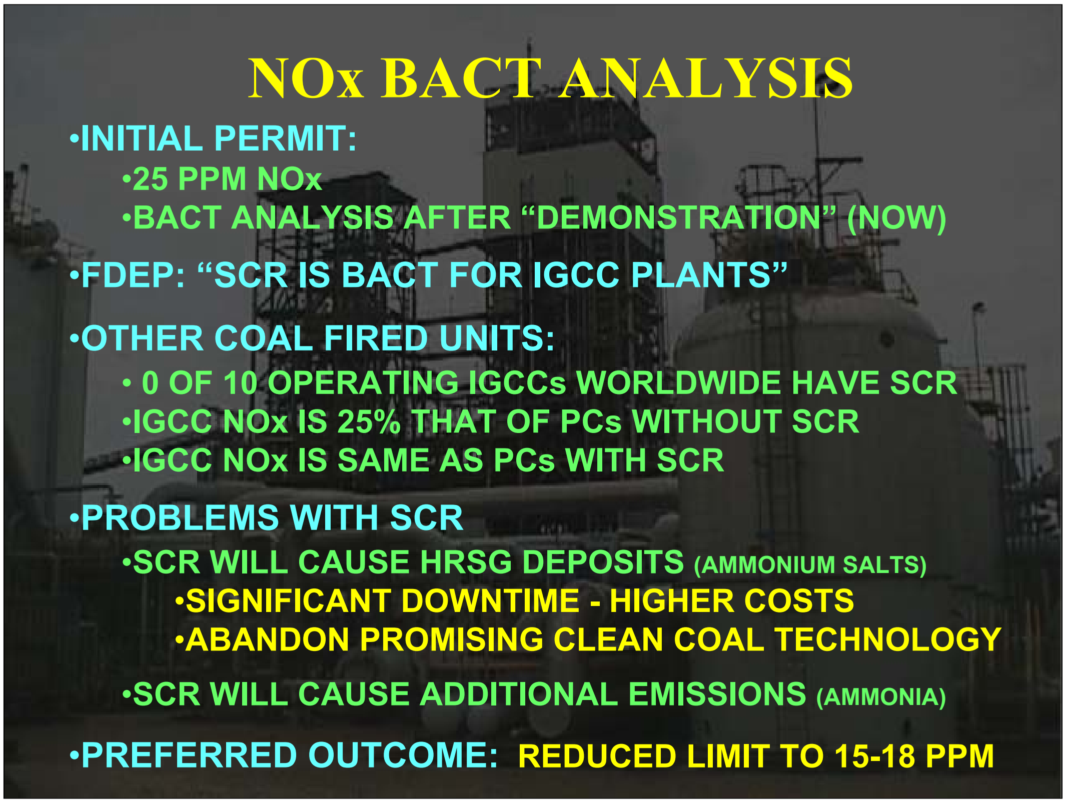
Some further process modifications in a recent outage this fall have enabled us to produce slag which is consistently suitable for the cement industry, but we must continue to operate at reduced load to do so. Load reduction is necessary because more oxygen is needed to gasify the fines, and our oxygen plant, specifically our main air compressor (MAC), cannot supply it. As shown on the next slide, the MAC cannot now even supply enough air to fully load the plant on a warm day.

A contractor experienced with power plant ash handling is currently installing equipment to separate the unconverted carbon from the slag we have stockpiled to date. We will then be able to recover its energy value in Tampa Electric's Big Bend pulverized coal power plant. In addition, it is essential for Polk's long term viability that we quickly find a source of more air for the oxygen plant to eliminate the load restrictions.



Polk's oxygen plant requires about 11½ MMSCFH of air to produce enough oxygen for full load operation on a variety of fuels over the normal ambient temperature range and to simultaneously reprocess enough fines to generate a slag product suitable for cement industry. This is about 8½% more than design.

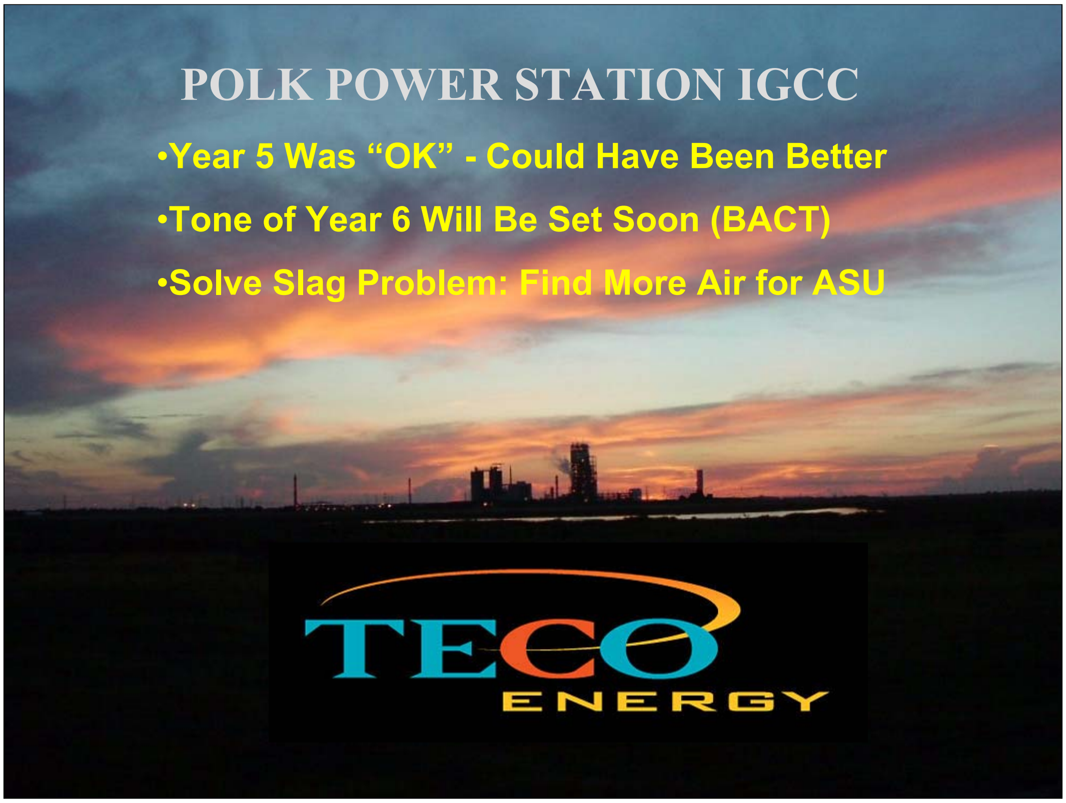
The main air compressor (MAC) could almost meet these requirements when it was new, but its output has deteriorated at a rate of about 2% per year. Now, at the peak ambient temperature on a normal Florida summer day, it is 15% deficient. 30% of this loss is attributable to pluggage of its aftercooler and the resulting backpressure. This is being remedied by replacing the aftercooler bundle and coating all carbon steel parts to prevent further deterioration. The remainder of the loss seems to be distributed throughout the machine, and there is not obvious way to recover it.



Polk's initial operating permit limited NOx emissions from the HRSG stack to 25 ppm (15% O_2, dry basis). It also contained the requirement that NOx control strategies be reevaluated at the end of the demonstration period. As a result of this evaluation, the Florida Department of Environmental Protection (FDEP) has concluded that selective catalytic reduction (SCR) is indicated for IGCC plants. Tampa Electric disagrees with this finding due to the lack of evidence of successful SCR operation on IGCC plants and IGCC's already low NOx emissions relative to other solid and heavy liquid based power plants.

The data does indicate that SCR costs for IGCC plants would be excessive. A key factor is that the residual sulfur in the fuel gas will react with ammonia which "slips" through the SCR system, forming ammonium sulfate and bisulfate deposits in the HRSG. These deposits would force frequent outages for cleaning, significantly driving up the cost of power. IGCC is already widely known to be costly, so, in a worst case, the requirement for SCR could cause us to abandon this promising clean coal technology.

We do believe that Polk can improve upon the current 25 ppm limit. By a combination of control system modifications and installation of additional proven process steps, Polk can stay within NOx limits of 15 to 18 ppm. This would provide a significant NOx reduction within the proven capabilities of the technology.



In conclusion:

Polk's recently completed fifth year of operation was acceptable, but clearly opportunities exist to improve. We expect to do better in year 6.

Important decisions with regard to NOx emission regulation at Polk will be made soon. An acceptable outcome is critical to Polk's future prospects.

Our work in the coming year will hopefully uncover a permanent solution to Polk's slag disposal problems and the related air deficiency.