Least Cost to Maximise Dust Collection in Electrostatic Precipitators

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Abstract: Electrostatic Precipitators (ESPs) are widely used to contain the particle emission from industrial plants, with coal-fired boilers as the largest user. Human health requires reduced particle emission. This paper lines up the most commonly used means to reduce the particle emission, and compares their relative cost. A deeper analysis focuses on relatively low-cost means to improve the ESP collection efficiency by energising and operating the ESP in new ways. This technology development has recently, at an accelerating pace, occurred during the last 5-7 years, and is still ongoing. Achieved emission reductions are really large, seldom smaller than 30%, and usually larger. New ESP operation–beginning by changing the way in which collecting plates are cleaned (but usually not changing mechanical components)–necessarily must be combined with co-ordinated operation of both conventional TRs and high-frequency energisers. This is today an emission-predictable means for which emission guarantees can usually be given on a plant-specific basis. This paper provides recent examples, both from USA and Europe.

Keywords: cost, dust collection, ESP, emission reduction

1 INTRODUCTION

The easy to understand and therefore common methods for increasing the collection efficiency of existing ESPs are:

- Upgrade of the ESP mechanical condition to "as new"–which always should include executing a new gas distribution of the ESP
- Add ESP collection area
- Add gas conditioning

Mechanical upgrades of all kinds are time-consuming and therefore usually require plant outage–which can create costly production losses. A mechanical upgrade usually commands a cost that begins at 10%-50% of the cost for a new ESP, but depending on what needs to be done the cost can also be much higher. But, of course, maintaining the mechanicals of an ESP is always a necessity sooner or later depending on the remaining plant life expectancy.

Gas conditioning is quite expensive-also from the operation cost point of view–and this is common for all gas conditionings, be it with sulfur trioxide or ammonia (or water or some specially designed additive). Conditioning–when it helps to reduce emission–always increases the ESP TR power consumption a lot. Typically the power consumption increase can be 25 % or more of a calculated annual cost for gas conditioning.

ESP mechanical upgrade is covered more in-depth in a paper by Lena Lillieblad–see reference 1.

A far less costly way to reduce the ESP emission–but not always an alternative to mechanical upgrade–is to improve the ESP overall control and operation. Quite often this can even be done without stopping the plant operation. If the emission reduction reached by control and operation improvements is sufficient, this is always the lowest cost option. Here are a few of the ways in which we then work:

- Energise the ESPs as efficiently as possible–to maximize the dust collection in each individual bus section. Methods to establish maximum secondary current/voltage by provoking sparks and recovering from them are key components, but this also includes the correct use of Intermittent Energisation /Semipulse.
- Continuously optimize every bus section energizing as efficiently as possible to maintain maximum dust collection efficiency.
- Clean the ESP as efficiently as possible when rapping. This requires interaction with the bus section energizer; so that when the rapping is executed the energizer feeds the correct power level (at times less than maximum) to the bus section. Most commonly the ESP collection plates shall best be rapped less frequently than was common practice, because every rap means a dust re-entrainment into the already cleaned gas stream.
- When gas conditioning is used–let the ESP control system execute the supervisory dosing of the gas-conditioning agent, to balance emission level and ESP operation cost.

The above-mentioned reduced rapping of the collecting plates gives a major reduction of the ESP mechanical maintenance cost, and increases the time between ESP maintenance stops.

Since the beginning of the 1980ies, Alstom (then named Fläkt and a little later belonging to ABB) has researched and implemented improved [electrical] control of the ESPs operation. Today in 2008 we may as a result from this know-how development be able to execute emission reductions that were unthinkable even only a few years ago:

In many cases we are able to predict-even for ESPs that work with low-resistive dust–stack emission reductions in the order of 30% or more, just by controlling the ESP operation in a better way. With SIRs added the emission reduction usually begins around 50%. And always with the use of our

ESP process experts to parametrise the software that keeps the ESPs at best performance during operation.

For high-resistive dusts the emission reduction can be even (much) higher than the mentioned 30%-50%. All on a case-to-case plant-specific basis, of course.

2 R&D ON A TIME SCALE FROM 1980 UNTIL CA 1986

When Fläkt and Mitsubishi invented and commenced to utilise Semipule/Intermittent Energisation as a means to improve the ESP collection efficiency for high resistive dusts, this started a rather slow growth of know-how. And although some modern TR controllers of that vintage–EPIC I was ours–were microprocessor based, they did not have a lot of number crunching capacity. EPIC I had 4096 bits of program code, while today's controllers have megabits of program code.

In 1980–1985 our R&D was mostly trial and error based at the ESP sites, a self-education learning effort for our experienced ESP process experts, like e g Christer Mauritzson and others. Semipulse ratios were tried and changed and retried, until a reasonable Semipulse optimum was found for each bus section. Just fixed settings–no signal feedback. During these years our ESP process experts often made IU curves, and could then eventually find a correlation between the IU-curve, the optimal Semipulse ration and the [lowest] emission. Would it be possible to design a control-loop based on this knowledge?

Around 1985 we started to market a supervisory unit, the EPMS system. This system communicated with and could consecutively order each EPIC unit to make a limited IU curve. Then it pooled the resulting data and selected one out of 12 pre-programmed Semipulse recipes (different for each bus section, of course) for the conditions found. The EPMS system allowed ESP plants to operate at lowest possible emission even when the coal quality was fluctuating. As each event of measuring the IU curve "steals" some collection efficiency, the optimisation could not be done too often, which limited the speed of the optimising.

Around 1987 we had found that the Semipulse Charging ratios [CR] available in EPIC I–between 1:3 up to max 1:15–was insufficient, and we altered the EPIC Is CR range to span between 1:3 and up to 1:127. This was another major breakthrough that drastically reduced the emission when the dust resistivity was very high

We also developed a microprocessor-based controller for tumbling hammer rappers, called EPIR. This controller connected to the EPMS supervisory system gave a limited possibility to synchronise rapping and TR power level, but from 1980 to 1990 we rarely used that possibility. We did have a software possibility to vary rapping interval with varying boiler load–but soon stopped using this feature, and removed it from later to be developed controller versions.

In 1986 we broke new ground again: We launched the ESP Process Monitor "ProMo" which was able to communicate over a conventional phone line (via huge 3 kbit velocity modems at both ends) with an EPMS system at site. The world's first remote ESP process surveillance, logger and operator unit was born. And the PCs we used had a 14-inch colour screen (albeit the screen display was only green).

3 ALSTOM ESP R&D ON A TIME SCALE FROM 1986 UNTIL CA 1990

The ESP technology development was relatively slow in our organisation during the years 1986 to 1990. However, we learned how to best use our tools: Semipulse was most important, and with ProMo we could log and correlate ESP operational changes over longer periods in the EPMS system–and often, because of the phone-line communication, without costs and time expenditure for travel.

We learned at the sites that with increasing dust resistivity, increased Semipulse ratios reduced the emissions. And as a consequence of the Semipulse operation the TR power consumption was often reduced with 90% or even more–and this at minimised emission. This was a hard apple to bite into, and even today in 2008 some plant level ESP experts in USA are reluctant to fully accept this, because they so seldom have these very difficult dusts.

We found–by and by–that while the Semipulse ratio has a major influence on the collection efficiency in an ESP bus section–the current supplied [or rather the specific current expressed e g in micro-amps per square meter] during the half-period used at Semipulse operation also greatly influences the collection efficiency. Knowing this, however, did not enable us to use the Semipulse current level in our optimising software, because the hardware we then had did not have enough capacity to calculate and execute what our ESP process experts wanted.

4 ALSTOM ESP R&D ON A TIME SCALE FROM 1990 UNTIL CA 2000–FLÄKTBUS, EPIC II WITH EPOQ SOFTWARE. PROCESS MONITOR PROMO II

Beginning after 1990 we introduced EPIC II, our second generation of ESP controller. This unit gave us fast number-crunching capabilities and new functions:

- High-speed sampling of ESP kV and mA signals to allow analysis of waveform.
- EPOQ software that with use of the waveform analysis calculates and sets the Semipulse ratio and current in the pulse that maximises the bus section collection efficiency. EPOQ does not use opacity meter for optimising.
- Rapper I/O hardware and software included in each EPIC II unit for improved redundancy
- An improved capacity industrial communications network–FläktBus–that allows up to 125 units to communicate with each other (but very slow compared with today's Ethernet)
- RTU (Remote Terminal Unit) panel, usually one for several EPIC IIs
- ProMo II equipped with FläktBus communication and with highly improved modem communication over public phone lines (also GSM mobiles later)

for remote ESP tuning, logging and surveillance.

With EPIC II the R&D really got a vitamin injection. For every ESP we wanted to study we could now analyse it both at site and from our technical centres (with ProMo and modems). We primarily used EPIC II with EPOQ and rapping software to maximise the collection efficiency when the dust resistivity was high. We published results from five selected ESP plants in the summer of 1996 at the ESP conference in Budapest.

We used the same equipment set-up and tuning philosophy in all ESPs that we built or upgraded since ca 1990, and could therefore have listed many more ESP plants in that paper. However, we choose to show only those five, because those results were "clean" in the sense that solely the control system had been exchanged combined with a renewed tuning of the ESP operation–but no mechanical alterations.

Over the years from 1995 until 2000 we were on a steep learning curve:

- We commenced to change/increase the [permissible] spark rate in dry ESPs from the 10 spm that had been standard for 50 years, up to much higher values for the entry fields. This philosophy was backed-up with several oscilloscope check ups to verify that an excessive amount of arcs was not created. The higher spark rate increases average corona current into some ESPs and reduces emission–without endangering the ESP mechanicals, as was the case (and is) with unsophisticated TR controllers (be they analogue old or modern, microprocessor-based). These high spark ratios are especially beneficial for ESPs after soda recovery boilers and other ESP processes with high amount of space charge.
- We started to more frequently use reduced TR power during the rapping of the collecting plates. We realised that the rappers can then clean the collecting plates more efficiently for processes where the common expert' view had been that PDR would give no emission reduction.

Our ESP process R&D during the period 1995–2000 gradually raised a requirement for more setting parameters when we intelligently combine collecting plate rapping and TR power control.

5 ALSTOM ESP R&D ON A TIME SCALE FROM 2000 UNTIL NOW, THE OLYMPIC YEAR OF 2008. ETHERNET COMMUNICATION, EPIC III WITH IMPROVED EPOQ SOFTWARE AND SOPHISTI-CATED RAPPER SOFT-WARE PCR. PROMO III WITH EVEN MORE CAPA-BILITY. SIRS GET THE SOFTWARE SOPHISTICATION OF EPIC III

We developed a completely new hardware–EPIC III–with improved rapper software PCR that was gradually introduced in the new millennium. PCR is a rapper software that gives many more rapper timers and synchronisation features, refer to paper reference 4 for more details.

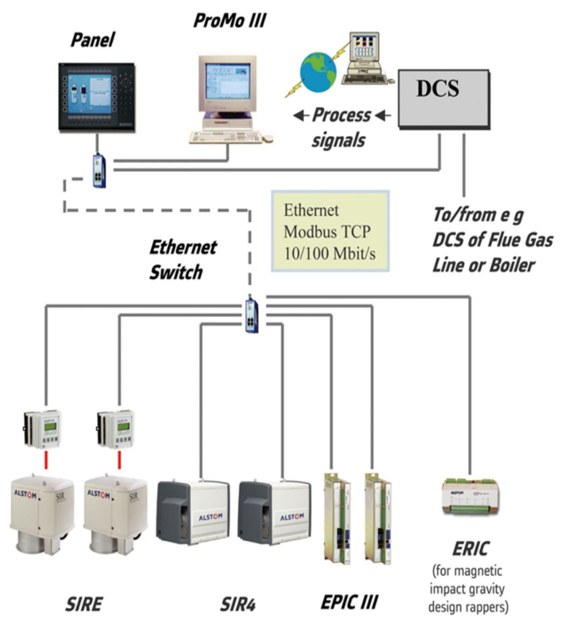


Fig. 1 Alstom's present range of ESP control and energizers

We included all features of the EPOQ and PCR software from the EPIC III into the SIR-range of high-frequency HVDC sets.

All our new control systems communicate via high-speed Ethernet using the TCP/IP protocol. Every controller has its own "home-page" which means that any standard PC can be hooked up and can address each individual controller on the network and serve as an RTU (Remote Terminal Unit).

The ProMo III is released and can be equipped with Internet communication. This for the first time allows high-speed communication with an ESP plant in almost real time from virtually any location in the world. The ProMo III is equipped with OPC server software, which is a standardised protocol that all modern DCS systems also can use. This means that, if desired, ProMo III can easily send data and receive orders from most in-plant DCS systems.

Here are some of our R&D landmarks between 2000-2008:

- With more rapper sophistication we realise that the collection efficiency can be increased for all types of dust–thus not only for high-resistive dust as we had published in 1996. Typically 30% emission reduction with low-resistive dusts
- Eventually we combined to totally remove TR power during the rapping of the collecting plates with rapping the collecting plates much less frequently. Even an ESP first field after a coal fired boiler, we would rap only once every 20-30 minutes –provided the dust handling system capacity allowed. When the dust handling system capacity was insufficient we rapped only a part of the collecting system–e g 1/3 of a tumbling hammer shaft revolution every 10 minutes instead of a whole revolution every 30 minutes–and found that this works fine in many cases

- Much longer collecting plate rapping intervals are used in all fields. A last field may thus be rapped only once per week–in Indian conditions only once per month! When we use PCR we generally do not use it during every collecting plate rapping event, but only as needed to deal with difficult dust that lingers on the collecting plates. This further reduces the ESP emission
- For dusts that have an elevated resistivity, the time constant in the dust layer on the collecting plates prevents the charges to disappear momentarily when the TR power is removed. In such cases we control the TR power some time before the collecting plate rapping is due to start. And thus we get the collecting plates even cleaner, and the emission decreases even further.
- We realise that the higher HVDC corona power levels that SIRs can provide necessitates PCR to reach full emission reduction. Operating SIRs without PCR may even result in no emission reduction at all.
- We realise that with high gas velocities that are common in old US-design ESPs, the SIR technology has a very high emission reduction capability when firing low to medium resistivity coals.
- SIRs are known to reduce the emission for all low-resistive processes, but with PCR and EPOQ are found to reduce emissions even when the resistivity of the dust is increased, compared with conventional TRs (e g reduced sulphur content in the coal).

6 EMISSION-REDUCTION ON A TIME-SCALE EXAMPLE: PEGO POWER STATION IN PORTUGAL

One of the exemplified ESP plants in the paper we published in Budapest in 1996 is the Pego Power Station located north of Lisbon in Portugal. With its two boilers with each two four-field ESPs we have had the opportunity over a few decades to increase the ESP dust collection efficiency with our competence growth–mind you only electrical improvements, no mechanical. And with several years interval we published papers on the improvements achieved. Fig. 2 dates back from the 1996 paper.

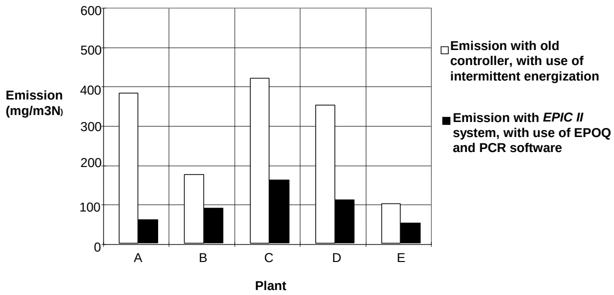


Fig. 2 Plant “A” is Pego. South African import coal, high-resistive fly ash. 2×320 MW boilers located in Portugal. Comparison made ca 1995-1996 between EPIC I controllers with intermittent energisation and new EPIC II controllers with EPOQ and PCR functions. Result: Emission reduced with 85%

The very high-resistive coals used for comparison under plant “A” in Fig. 2 could never be used in continuous operation during the EPIC I years (1988-1996), because an emission at nearly 400 mg would not have been acceptable. Instead other South African coals giving a lower resistivity ash (containing more sulphur) were used during those years–giving an emission level around 120 mg. Fig. 3 below, excerpted from a paper published in 2003 shows this.

After the upgrade to EPIC IIs the emission with difficult South African coals stayed between 90 mg-120 mg, which is in reality a tremendous improvement–shown as “A” in the Fig. 1 diagram above. Pego mostly burn a coal mix at 75% South African and 25% Columbian, that initially from 1997 gave an emission of 40 mg-45 mg. But with the same coals and better application of PCR and EPOQ in 2002, we reduced that emission to a mere 25 mg-35 mg. Experiments in 2002 showed that introducing SIRs may reduce this emission further

In 2008/2009 we will upgrade the Pego ESPs with combinations of SIRs and EPIC IIIs.

Fuel Combinations	Semi-difficult South African coal	Difficult South African coal	75 % South African 25 % Columbian
1988-1996 EPIC I	Ca 120 mg/Nm^3	Ca 400 mg/Nm^3–never used	Not used
1997-2001 EPIC II and “early” PCR		90-120 mg/Nm3	40-50 mg/Nm^3
2002 EPIC II and PCR		40-50 mg/Nm3	25-35 mg/Nm^3
2002 SIR in first field, EPIC II and PCR		30-35 mg/Nm3	Less than 25 mg/Nm^3

Fig. 3 Overview of emissions levels and reductions at Pego 1988-2002. All above values mg/Nm^3 wet. Same emission–ca 25-35 mg, as marked with fat text–is still obtained today, 2008

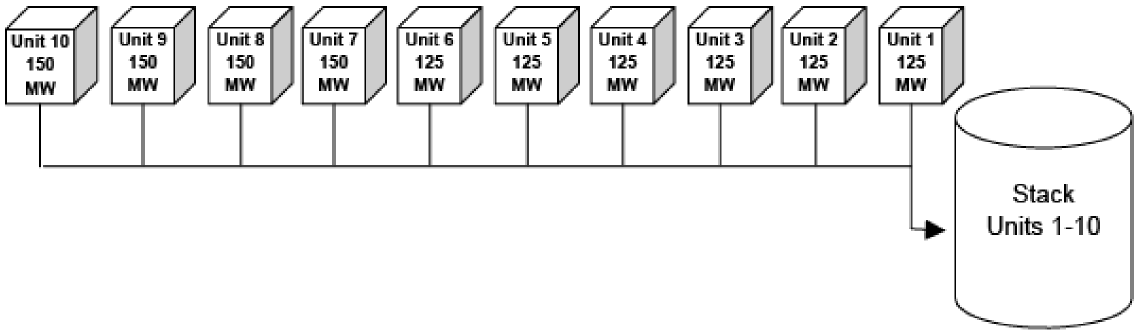


Fig. 4 Units 1-6 150 MWe, units 7-10 150 MWe. Total 1350 MWe

7 ESP EMISSION-REDUCTION WITH TARGET TO REDUCE THE SO_2/MBTU EMISSIO

This coal fired utility plant located in USA, is designed–as are so many USA plants–to combust coal with relatively high sulphur content, approaching 2%. For both environmental and commercial reasons this plant had decided to reduce the SO_x stack emission by switching to coals with lower sulphur content. As less sulphur in the coal increases the ash resistivity, the ESP collection efficiency would have to be increased quite a lot to cope with those more difficult conditions. This order contains no ESP mechanical upgrade, only electrical equipments and new controls–and the tuning/ parametrising work of our ESP process experts:

- Units 1-6: Replace existing TRs with SIRs (6×8=48 sets)
- Units 7-10: Replace existing control system with EPIC IIIs (40 sets total)
- Install a new surveillance and logging system for all the ESPs in the plant
- In addition to the project's quite demanding performance objectives, the ESPs upgrade was not allowed to affect the plant generating capacity throughout the entire installation

Many, many alternative solutions on how to best execute the ESP efficiency improvement [with electrical means only] were compared for cost and emissions, both with and without the use of SIRs and/or with gas conditioning in use or not–and most importantly: For different chemical coal composition, where the sulphur content was the most (but not the only) important factor. The relative best solutions were then eventually decided upon, resulting in the schematic scope of delivery as shown in Figs. 5, 6 and 7. Then followed the real coal switch execution.

8 TARGET WITH THE COAL SWITCH

In absolute terms, the customer wanted to execute the upgrade to allow the use of coals with a content of 1.4-1.5 lbs SO_2/Mbtu, which translates into a reduction by ca 30% of the coal blend SO_2 content prior to the upgrade. Any further reduction–without violating the permissible particle emission (as expressed in Opacity %) would, of course, be beneficial.

The customer switched coal quality in a planned manner by buying specified coal mixes. He thus in a controlled way gradually reduced the sulphur content-which in turn gradually increased the ash resistivity. Alstom ESP process experts introduced our ESP optimising software PCR and EPOQ–not all features at once, and not in all bus sections at once. Therefore the emission reductions could be recorded step-by-step-when the new ways to operate the ESPs were introduced.

The step-by-step inset of the optimising software and the subsequent tunings gave Alstom (and the customer) the possibility to judge both if and also how much further–better than estimated at proposal–the emission could be reduced. The substantially reduced power consumption for almost the same emission levels–but with more difficult to collect ash–really astonished several local ESP experts. These improvements had been expected by senior Alstom ESP process experts–interesting for us were the hard facts documented that were actually documented at this site.

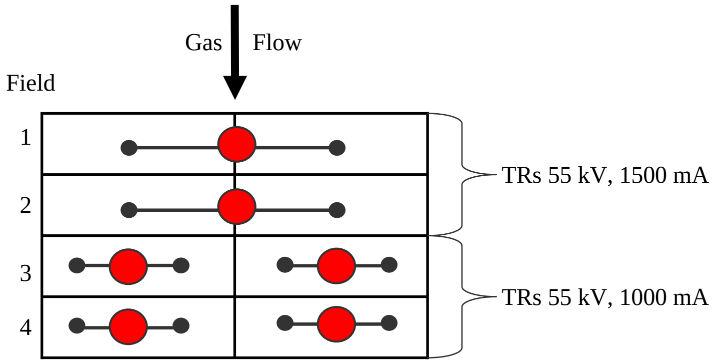
Fig. 6 gives the layout and data the ESPs on units 1-6 before the upgrade, and figure 7 after the upgrade. Figure 8 gives the coal data before and after the coal switch on units 7-10. Fig. 9 gives the layout and data for the ESPs on units 7 and 8, while figure 10 gives layout and data for the ESPs on units 9 and 10.

Please note that while the data in figure 6 and 7 are in principle valid for all the ESPs after boilers 1-6, the data were only gathered after boiler 4.

The boilers 7-10 all fired the same coal mixtures prior to the upgrade with EPIC III controllers. These coals were different from the coal mixtures then normally fired in Boilers 1-6. After the upgrade a coal quality with substantially less sulphur content was used, and this even before EPOQ had been started. ESP collection efficiency increased with use of EPOQ.

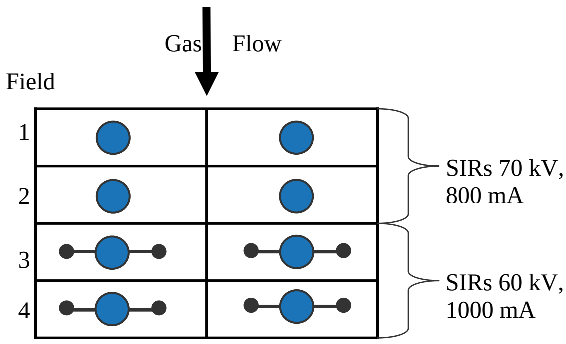
The flue gases from all ten boilers are taken to a common stack with one common opacity meter. After the coal switch in all boilers and the ESPs tuning of the ESPs, the overall SO_2 emission is now lower than before the coal switch.

Fig. 5 SIR supply rated 70 kV, 800 mA or 60 kV 1000 mA (identical exterior)



TR Power (kW)	Opacity (%)	Sulphur (%)	Total Moisture (%)	Volatiles (%)	Ash (%)	Fixed Carbon (%)	Heat Value (Btu/lb)
100	16	1.3	19.5	32.8	7.4	39.0	12.788

Fig. 6 Boilers 1-6. As-Received Coal analysis and ESP data before coal switch and before upgrade (ESP data after boiler 4 only)



EPOQ	TR Power (kW)	Opacity (%)	Sulphur (%)	Total Moisture (%)	Volatiles (%)	Ash (%)	Fixed Carbon (%)	Heat Value (Btu/lb)
Not used	300	13	0.82	18.4	32.0	7.1	41.7	10.518
Partially	120	15	0.67	19.7	32.2	6.7	40.7	10.279
All fields	125	13.5	0.52	21.2	33.6	6.5	38.2	9.958

Fig. 7 Boilers 1-6 ESP coal data and ESP behaviour after electrical upgrade with SIRs. Coal as-received sulphur contents 0.8%, 0.7% and 0.5% are shown, with different levels of EPOQ operation (ESP measurements made after boiler 4 only)

Sulphur (%)	Total Moisture (%)	Volatiles (%)	Ash (%)	Fixed Carbon (%)	Heat Value (Btu/lb)
1.5	17.4	32.1	7.2	41.8	10.456
0.94	10.1	33.5	8.6	46.9	11.882

Fig. 8 As-received Coal qualities in boilers 7-10 before and after coal switch

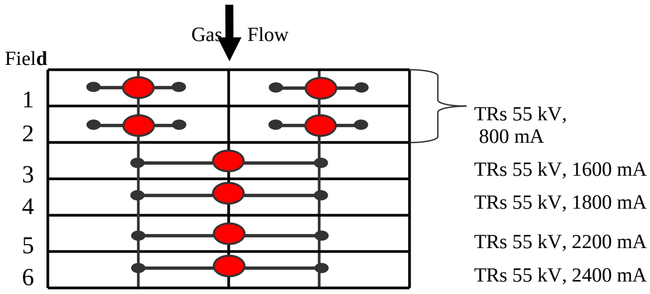


Fig. 9 T/R Layout for Units 7 & 8. New EPIC III controls and ESP tuning

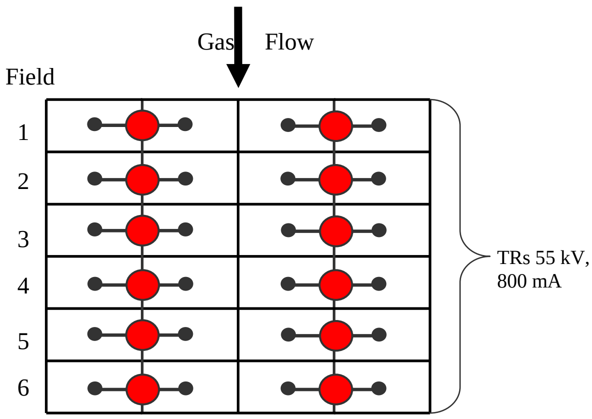


Fig. 10 T/R Layout for Units 9 & 10. New EPIC III controls and ESP tuning

Final results after upgrade and ESP tuning: All 10 boilers can now combust a lower sulfur coal, with some unit's sulfur content as little as 1.0 lb SO_2/Mbtu, while remaining at an acceptable particle emission level

After completion of the ESP upgrades, the 1.4-1.5 lbs SO_2/Btu coal blend was fired in all ten units, but with a completely different mix for units 7-10 because of coal mill limitations. Although an increase in stack opacity had been expected, values similar to those achieved with the high sulfur coals were observed and even reduced.

It was then decided to take the next step in reducing the SO_2 emissions by lowering the coal SO_2 content further. The final coal blend tested yielded a concentration of only 1.0 lb SO_2/Mbtu, a goal previously set for years in the future. With the ESP's optimized to their maximum using EPOQ and PCR, a truly outstanding result was obtained. Stack opacity remained at the same level, despite the additional sulphur reduction.

Fig. 11 Roof Elevation of Units 1-6 after Project Completion

9 CONCLUSIONS

Proven new ways to operate both the energising and rapping of the ESP along with the use of dedicated emission minimising software can be used to reduce the dust emission by double-digit percentages for all ESPs that presently do not yet use these new methods–provided that the ESPs are mechanically sound.

Applied in ESP plants that were initially designed to combust high-resistive coals, this may–at same or reduced particulate emission–allow the combustion of coals that give ash with even a very much higher resistivity than the ESPs had originally been designed for. Thus the SO_x emission of the plant can be reduced. This was done step-by-step over decades at the Pego Power Station in Portugal. Results:

- lower particulate emissions
- lower SOx emissions by switching to lower sulphur coals
- drastically lowered power consumption- saving often better than 95 %
- much lower mechanical maintenance cost for the ESPs

Applied in ESP plants that were originally designed to combust low resistive coals (in the order of e g 2% sulphur content) a reduction by e g 50% of sulphur content gives a much higher absolute reduction of sulphur emission than in the above Portugal example. The USA-example in this paper provides:

- lower particulate emissions
- lower SO_x emissions by switching to lower sulphur coals
- Increased power consumption or reduced power consumption depending on if Semipulse–as automatically controlled by EPOQ–will be in operation. Semipulse operation drastically reduces power consumption

- much lower mechanical maintenance cost for the ESPs

Depending on individual case-to-case specific conditions–independent of the mechanical design of the existing ESP–Alstom is usually in a position to estimate or guarantee a new reduced emission by the use of SIRs or EPIC IIIs with software EPOQ and PCR, or combinations thereof.

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ABBREVIATIONS EXPLAINED

EPIC is Alstom's brand of TR controller. Each EPIC controls both the TR and the rapper operation, and system real time is always synchronous between the controllers

SIR is Alstom's brand of switch-mode high-frequency HVDC supply for ESPs. SIR is 3-phase powered, and is built as one complete unit in one box. SIR has no separate control cabinet. Rapper controller is also included in each SIR. SIRs provide the ESP bus section with an almost ripple-free HVDC compared with a conventional TR that may have a ripple of 30-40

ProMo is Alstom's brand of HMI-interface for ESPs. ProMo is also a logger and has provisions for remote tuning the ESP via Internet or phone line. Much of our R&D could only be made in an efficient way thanks to ProMo.

Semipulse™ The TR controller when set to operate a TR in Semipulse™ mode does not use all half periods of the mains frequency (50 or 60 Hz), but only every 3rd , every 5^{th,} every 7th etc. The Semipulse™ ratio in the above cases would be 1/3, 1/5, 1/7 etc. Semipulse™ is used with high-resistive dusts to increase the ESP collection efficiency. Semipulse™ technology was invented in the early 1980ies, and is also known as "Intermittent Energisation" or "IE". SIR units can use Semipulse™ with increased flexibility. Semipulse™ operation saves the majority of the TR power consumption.

EPOQ software in EPIC III can maximise the bus sections' collection efficiency. EPOQ is short for Electrostatic Precipitator maximising of "Q", where "Q" represents electrical charge. EPOQ continuously analyses mainly the kV waveform and selects both the optimal Semipulse™ ratio and the optimal current level.

Sometimes–mainly for very high-resistive dusts–our ESP process experts may find it more favourable to use EPOQ as a diagnostic tool, and then select fixed Semipulse™ ratios and currents.

PCR Every EPIC III and every controller in a SIR comprise rapper control outputs. PCR (short for Power Control Rapping) is a tool for the ESP process expert that allows him or her to set the TR energy during rapping to desirable values. PCR usually uses its own set of timers, but would be used in strict correlation with the collecting plate rapper timers. PCR makes it possible for a knowledgeable ESP process expert to reduce the amount of residual dust on the collecting plates–and its resistivity.