SCI-Pak

Sustainable and Cleaner Production in the Manufacturing Industries of Pakistan

Boiler Efficiency

Training of Boiler End Users
&
Training of Boiler Manufacturers
Day 2

Funded by the European Commission

Increased Steam Boiler Efficiency

Feed Water Economizer

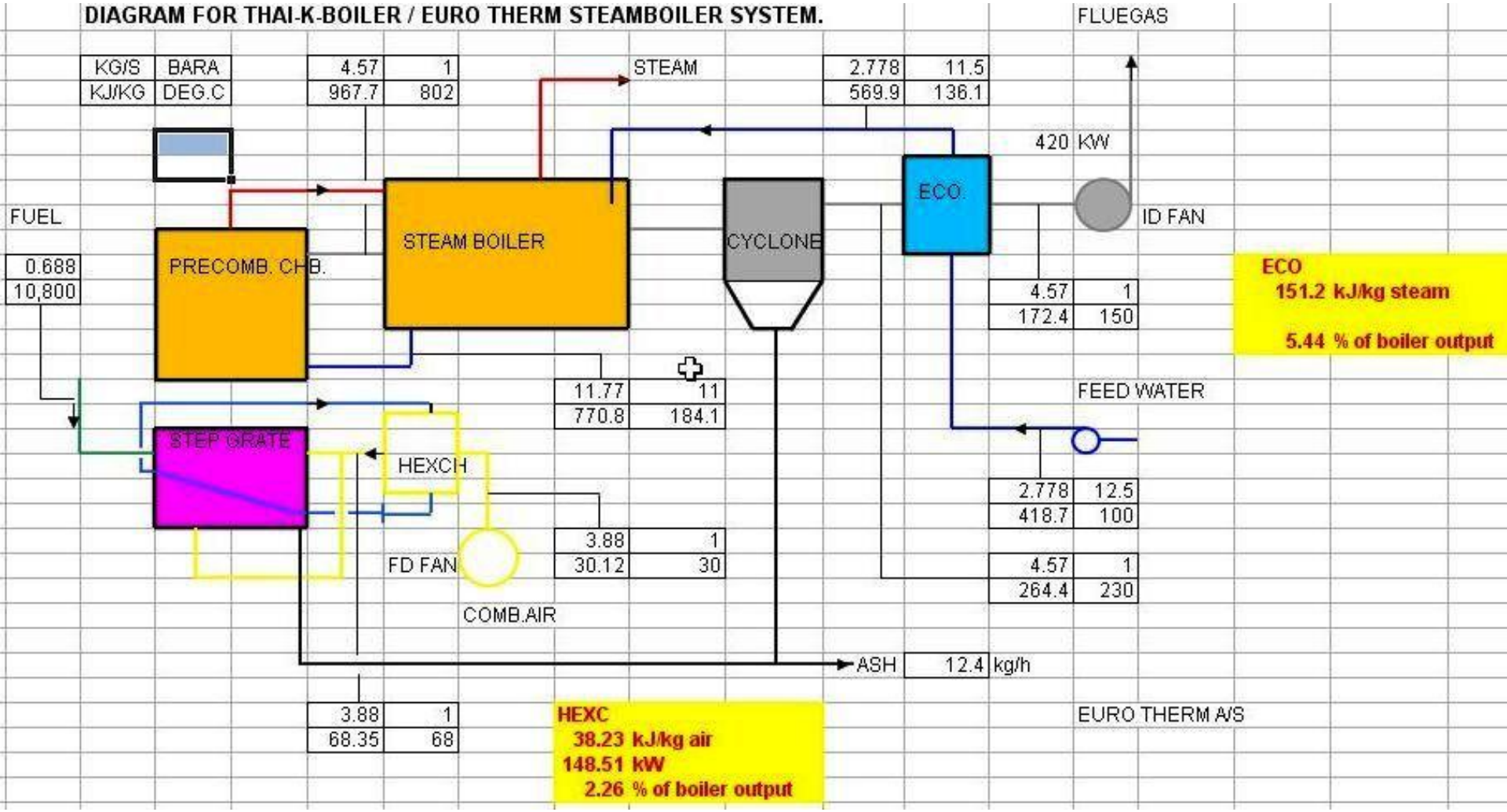
Air Preheater

Boiler Blow Down Heat Recovery

Combustion Control

Furnace and Boiler Design

Steam Boiler Mass/energy Balance

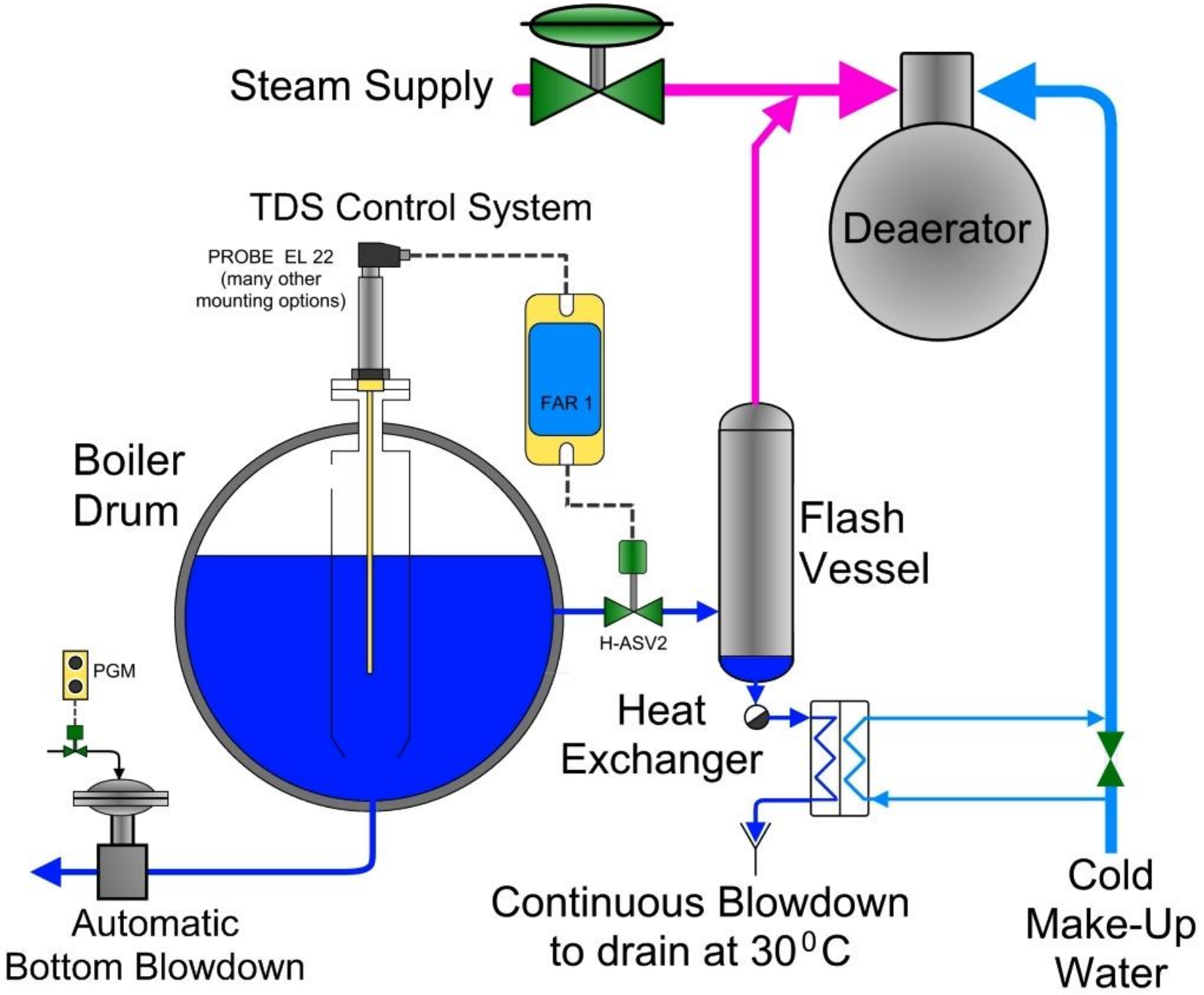


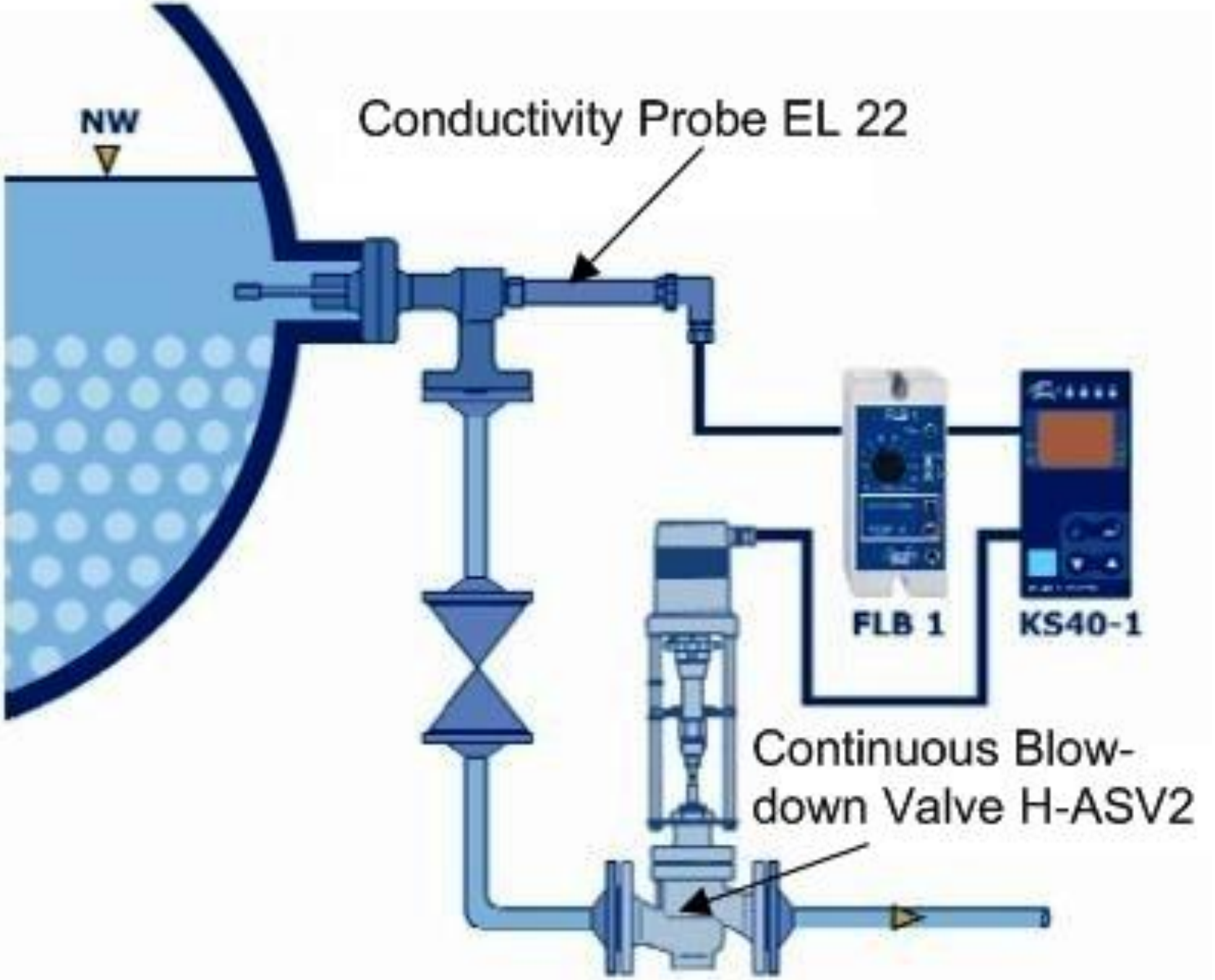
Financial Impact of Boiler Efficiency

- Coal LCV = 6,000 kcal/kg
- Coal Price = 90 $/kg
- 10 MW (th) Fire Tube Boiler; efficiency **70 %**
- Steam Generation Costs = **18.52 $/ton**
- Fuel expense (7,000 hours/y) =>**1,291,238 $/year**
- System Efficiency **80 %** (+ Eco + Air Pre Heater)
- Steam Generation Costs = **16.70 $/ton**
- Fuel expense (7,000 hours/y) =>**1,129,873 $/year**
- System Efficiency **85 %** (State of the art technology)
- Steam Generation Costs = **15.95 $/ton**
- Fuel expense (7,000 hours/y) =>**1,063,410** $/year

Financial Impact of Combustion Control

- Combustion Control => Reduced air surplus/ reduced O_2 in the Flue gas
- Combustion Control => Reduced CO in the Flue Gas
- Increasing the Air Surplus from 1.4 to 1.6 => 13 % increase in the Fuel Consumption
- 10 MW(th) boiler, 7,000 hr/y => + 147,000 $/year
- Reduced CO Emissions 5,000 ppm - 250 ppm => 2.14 % fuel saving = - 24,179 $/year


Steam Supply
Deaerator
TDS Control System
PROBE EL 22
(many other
mounting options)
FAR 1
Boiler
Drum
Flash
Vessel
H-ASV2
PGM
Heat
Exchanger
Automatic
Bottom Blowdown
Continuous Blowdown
to drain at 30 0C
Cold
Make-Up
Water


NW
Conductivity Probe EL 22
FLB 1
KS40-1
Continuous Blow-down Valve H-ASV2

Boiler Blow Down Heat Recovery

- The most cost-effective method is a two-stage heat recovery system.
  In the first stage, blow down water is expanded in a flash vessel from boiler pressure to feed tank or deaerator pressure. Flash steam is thus utilized for pre-heating of boiler feed water.
  As flash steam condenses, its water content is also saved.
  In the second stage, the residual blow down, after flash steam extraction, is piped to a heat exchanger, where it gives up a substantional portion of its sensible heat to cold make-up water.
- Continuous Boiler Blow Down up to 8 -10 % of the steam capacity is not uncommon (save money on water quality!)
  For the 10 MW_{th} steam boiler the increased fuel costs are ~ **120,000 $/year**

Unburnt Carbon in the Ash

TABLE 1 TYPICAL VALUES OF UNBURNT CARBON FOUND IN ASH.

Sl. No.	Type of Fuel/Furnace	Unburnt Carbon Percentage (W/W in Residue)	
		Furnace	Fly Ash
1.	Travelling Grate Furnace - Coal Firing	10 - 20	8 - 15
2.	Dry Bottom Furnaces - Bituminous Coal Firing	2 - 8	1 - 5
3.	Dry Bottom Furnaces - Brown Coal / Lignite Firing	2 - 6	1 - 5
4.	Circulating fluidised bed furnaces - Biomass Firing	-	6 - 12

% of Unburnt in the Ash!

Ash is from 2 - 20% of the fuel input => 0.2 – 4 % of fuel. On a chain grate with good combustion control ~ 1 %