SUMITOMO - FOSTER WHEELER CFB BOILER

SHI Sumitomo Heavy Industries

Reliable & Proven Design for Circulating Fluidized Bed Boiler CFB Power Plant by Sumitomo

1. Sumitomo Heavy Industries in brief
2. Principals of CFB technology
3. Reliable design
4. Hard design improvement
5. Track Records

Sumitomo Heavy Industries, Ltd.

1. Sumitomo Heavy Industries in brief

Sumitomo Group in brief

A Member of Sumitomo Group

· Sumitomo Heavy Industries(SHI)	--Industrial Machinery & Engineering
· Sumitomo Chemical	--Fine Chemicals
· Sumitomo Metal	--Steel
· Sumitomo Mitsui Banking Co.	--Banking & Financing
· Sumitomo Corporation	--Corporation
· Sumitomo Electric	--Electrical/Optical Cable
· NEC	--Electronics
· Sumitomo Osaka Cement	--Cement & Ceramics
· Sumitomo Warehouse	--Logistics
· Mazda	--Automobile
· Asahi Beer	--Brewery
· Meidennsha	--Heavy Electrical
· Nippon Sheet Glass	--Glass
· Sumitomo Mitsui Construction	--General Construction

Total 47 companies, 266 thousand employees

Sumitomo Heavy Industries in brief

Products Line

Component Technologies for Coal Fired Power Plant


Turbines and Pumps


Boiler


Pressure Vessels


Water Treatment


Cooling Tower

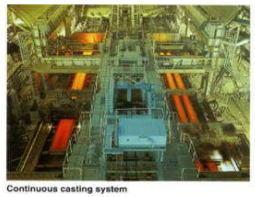

Material Handling


Bag Filter


Ash Handling

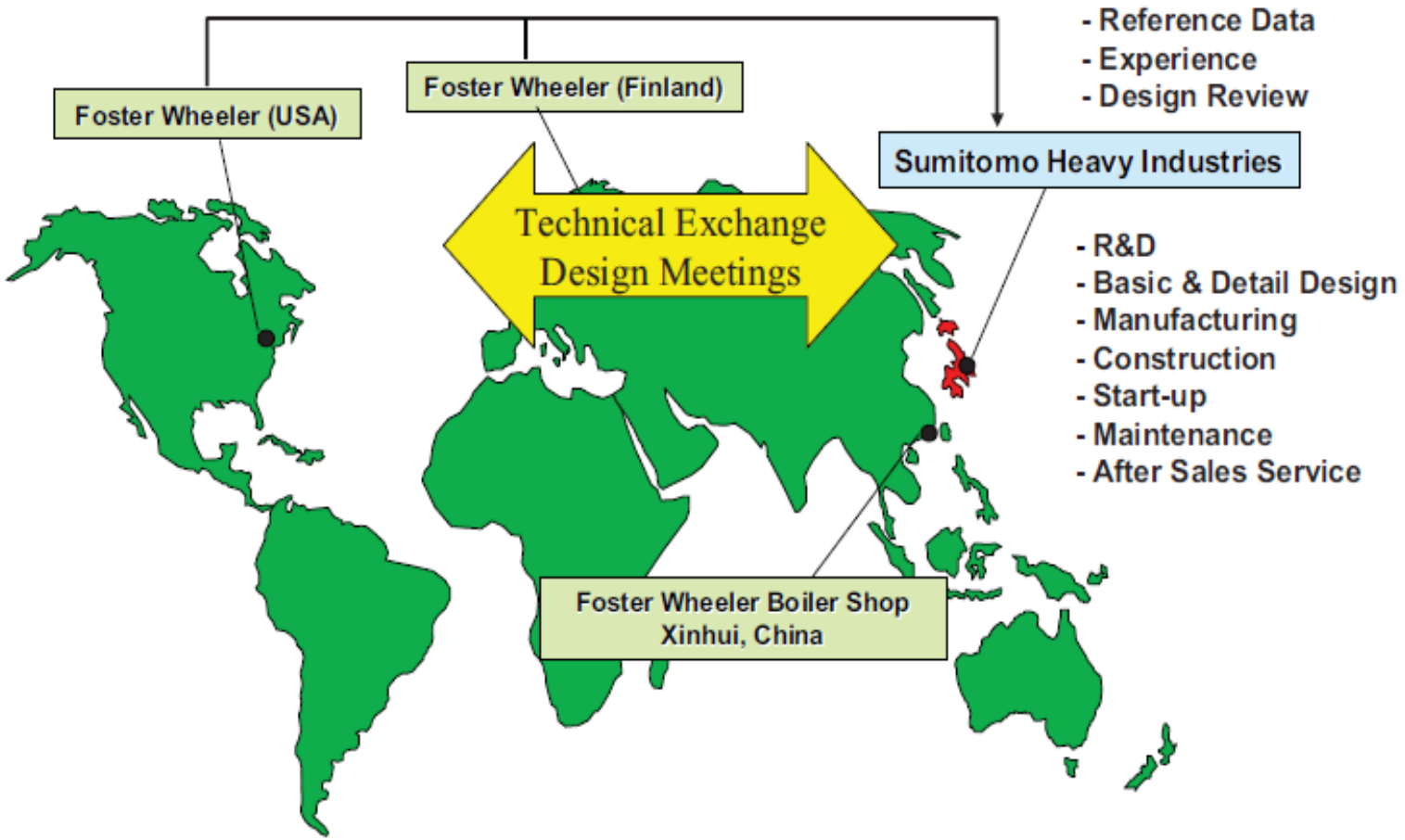
Other Industrial Machinery


Akashi-Kaikyo Ohashi Bridge


Continuous casting system

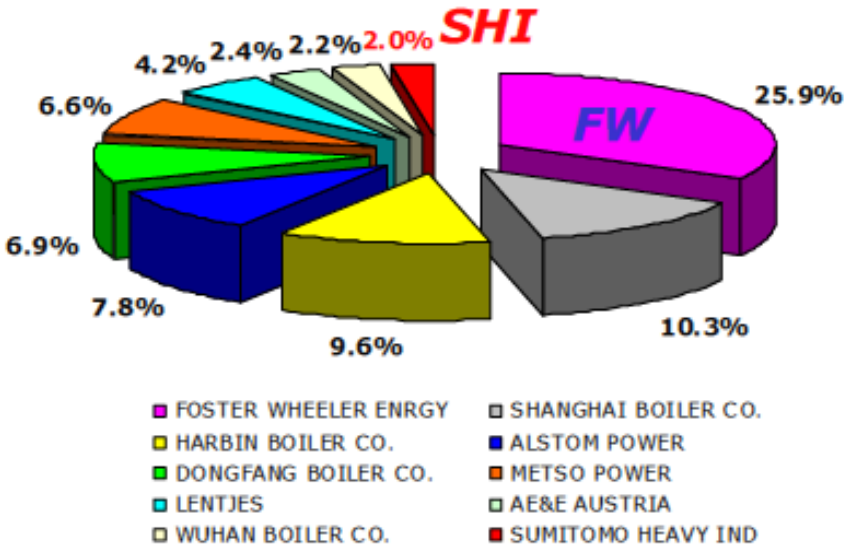

Bucket elevator type continuous unloader

Sumitomo - Foster Wheeler Alliance



Sumitomo - Foster Wheeler CFB Market Share

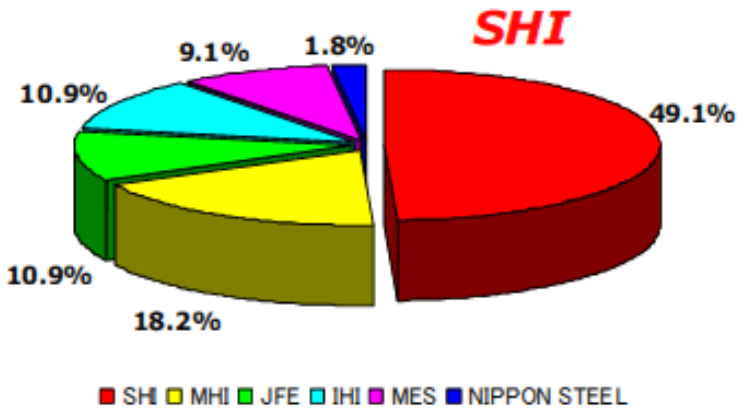
Foster Wheeler
CFB Market Leader in the world



Total 881 Units

(1980-2008)

Sumitomo - Foster Wheeler
CFB Market Leader in Japan



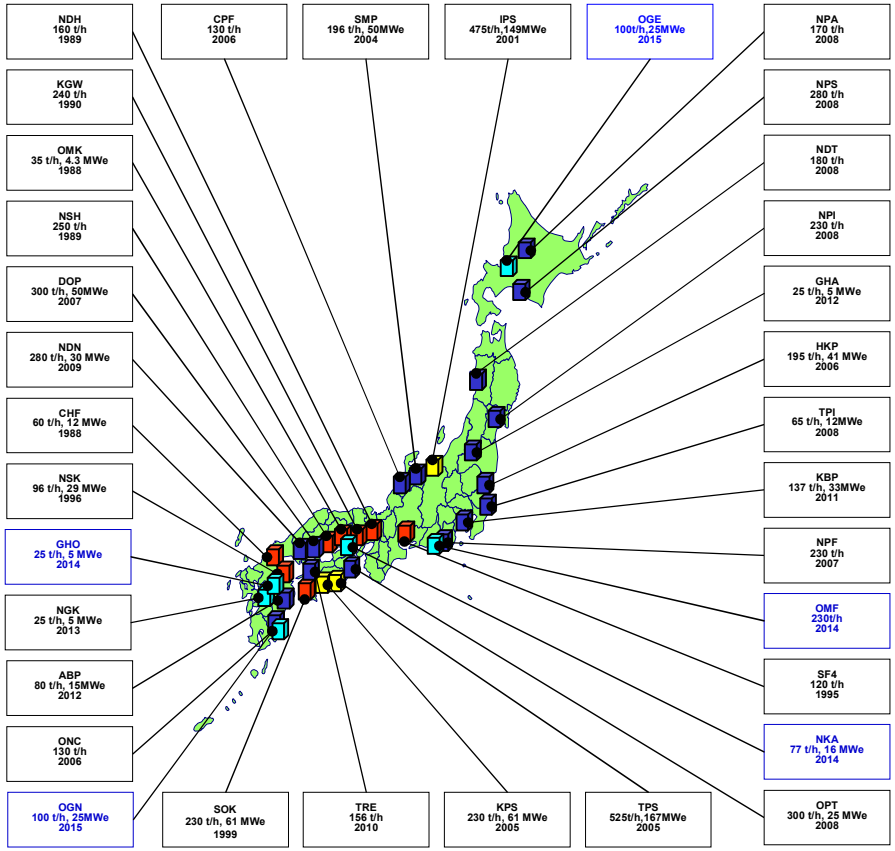
Total 55 Units

(1982-2009)

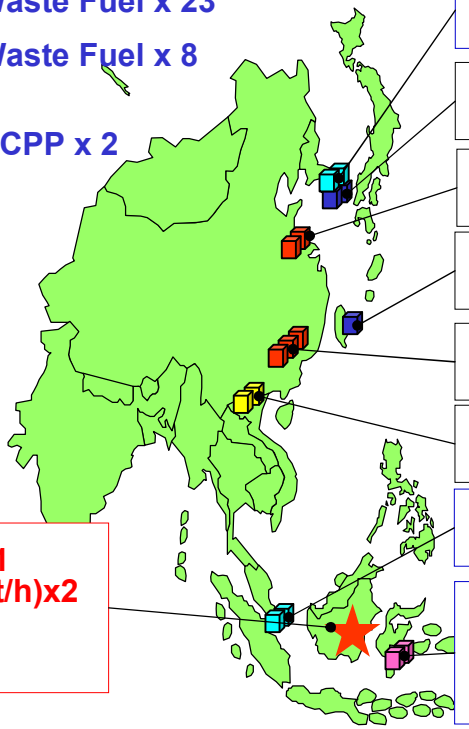
Source: 2008 McCoy Power Reports, All boiler types and sizes, Excludes domestic orders provided by domestic suppliers in China, India, Japan, and S. Korea, Other includes suppliers with less than 2% market share, Market Share based on MWe

Delivery Record of SHI's CFB Facilities

Status	JAPAN	Other Countries	Total
In Commercial	29 units	11 units	50 units
On Going	5 units	5 units	



- Coal Fired Cogeneration x 13
- Coal Fired IPP x 5
- Biomass/Waste Fuel x 23
- Biomass/Waste Fuel x 8 (On Going)
- Coal Fired CPP x 2 (On Going)



KMH2, Korea
400 t/h x 2
2014

KMH, Korea
250 t/h x 2
2009

JOP, China
200 t/h x 2
2011

CPH, Taiwan
130 t/h
2012

BCG, China
220 t/h x 3
2005

VND, Vietnam
205 t/h x 2
2005

TBS, Singapore
450 t/h x 2 (+1)
2012/4(/6)

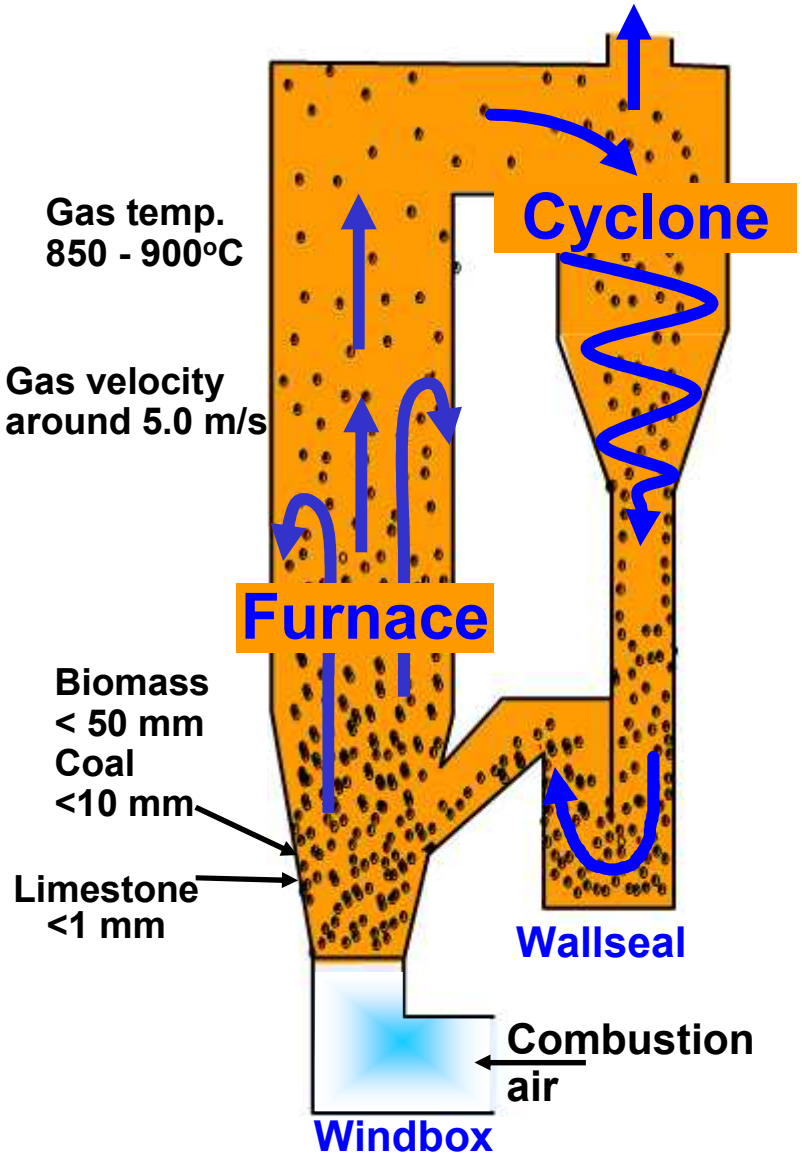
Kalsel 1
115MW(406t/h)x2
2016
(LI)

Antam
30MW (125t/h) x 2
2015

2. Principals of CFB technology

2. Principals of CFB technology

2-2. Principally Fuel Flex Furnace



- ☑ **Long Combustion time**
  Circulating combustion realizes better combustion efficiency for un-reactive fuels.
  Low volatile fuels etc.
- ☑ **Large heat capacity in Furnace (Bed)**
  Large heat capacity makes high moisture fuels stable combustion.
  High moisture coal, Biomass, Peat etc.
- ☑ **Controlled (designed) Furnace temperature**
  Reasonable Emission control
  Avoiding clinkers / Slugging
  Low melting Ash (>1150'C) Fuel NOx SOx
- ☑ **Well Fluidization in Bed Area**
  Fluidization makes fuel spreading, crushing, and avoiding heat spot
  Large size fuels, various figure fuels, Renewable Fuels (Tire, RPF, etc)

Please see VIDEO of CFB Boiler.

Sumitomo – Foster Wheeler CFB Fuel Experiences

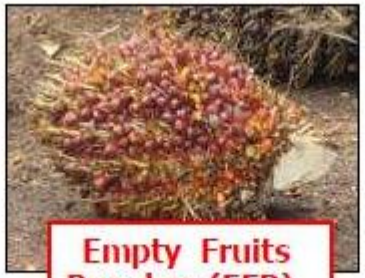
Coals (Lignite, Bituminous, Anthracite), low grade coal, pet-coke
Renewable energy fuels (Biomass, TDF, RPF, Sludge, etc.)

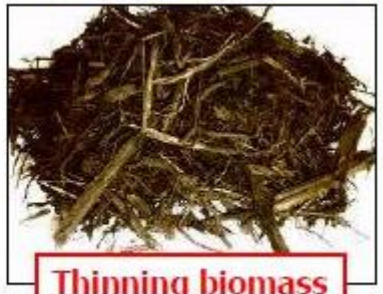

Coal


Demolition wood


Tire Derived Fuel (TDF)


Refuse Paper and Plastic Fuel (RPF)


Empty Fruits Bunches (EFB)


Thinning biomass

Item	Range	Typical Fuel
Moisture	Up to 60%	Lignite Coal, Peat, Sludge
Ash	Up to 76%	Waste Coals
Sulfur	Up to 8%	Waste Coals, Petcoke
Volatiles	Down to 0%	Petcoke
LHV(AR)	Down to 1,500 kcal/kg	Waste Coals,Biomass

3. Reliable design

CFB pilot combustion test -Test facility

CFB PILOT TEST FACILITY OVERVIEW

SHI Niihama Laboratory
Ehime pref. , Japan

-Outline-

Thermal input 1 MWth
Furnace ϕ600 x 20mH

-All fuels are tested by the pilot facility before actual commercial boiler design

-Every single fuel & co-combustion technology are developed by means of this facility

-More than 100 combustion tests were held in past 9 years

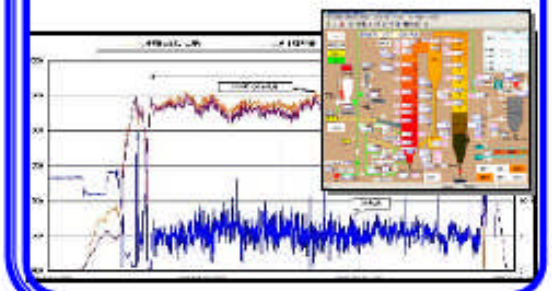
Pilot Plant Combustion Test with Actual Fuel

SHI has its own pilot scale CFB plant in Japan

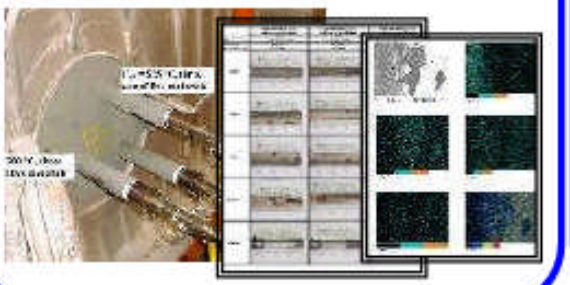
Actual Fuels

Fouling and fluidization

Combustion and emission



Corrosion information

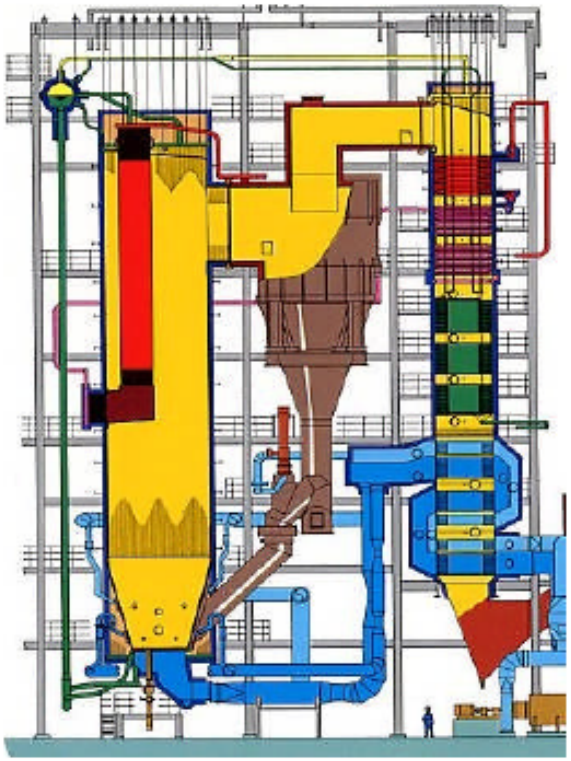


Ash property

4. Hard design improvement

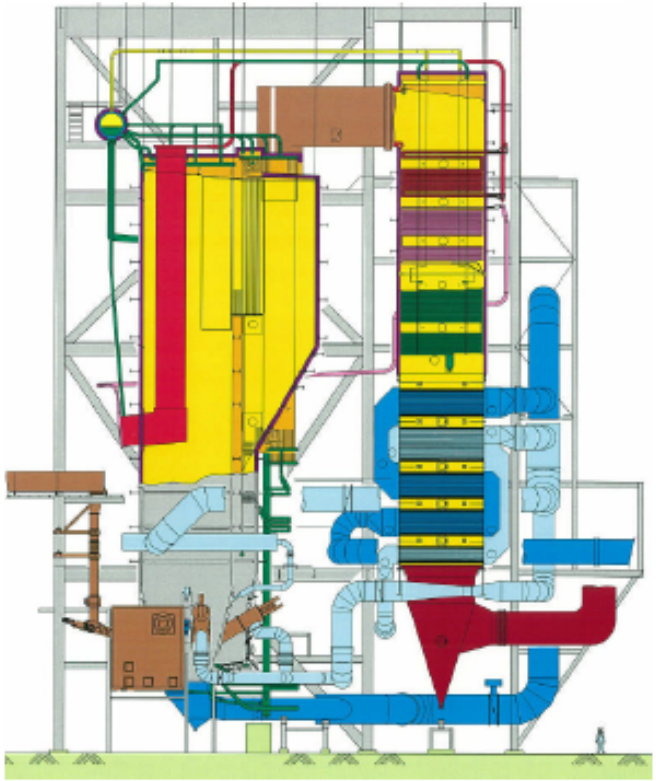
Foster Wheeler Compact CFB Design

Conventional CFB
= [PLATE CYCLONE]



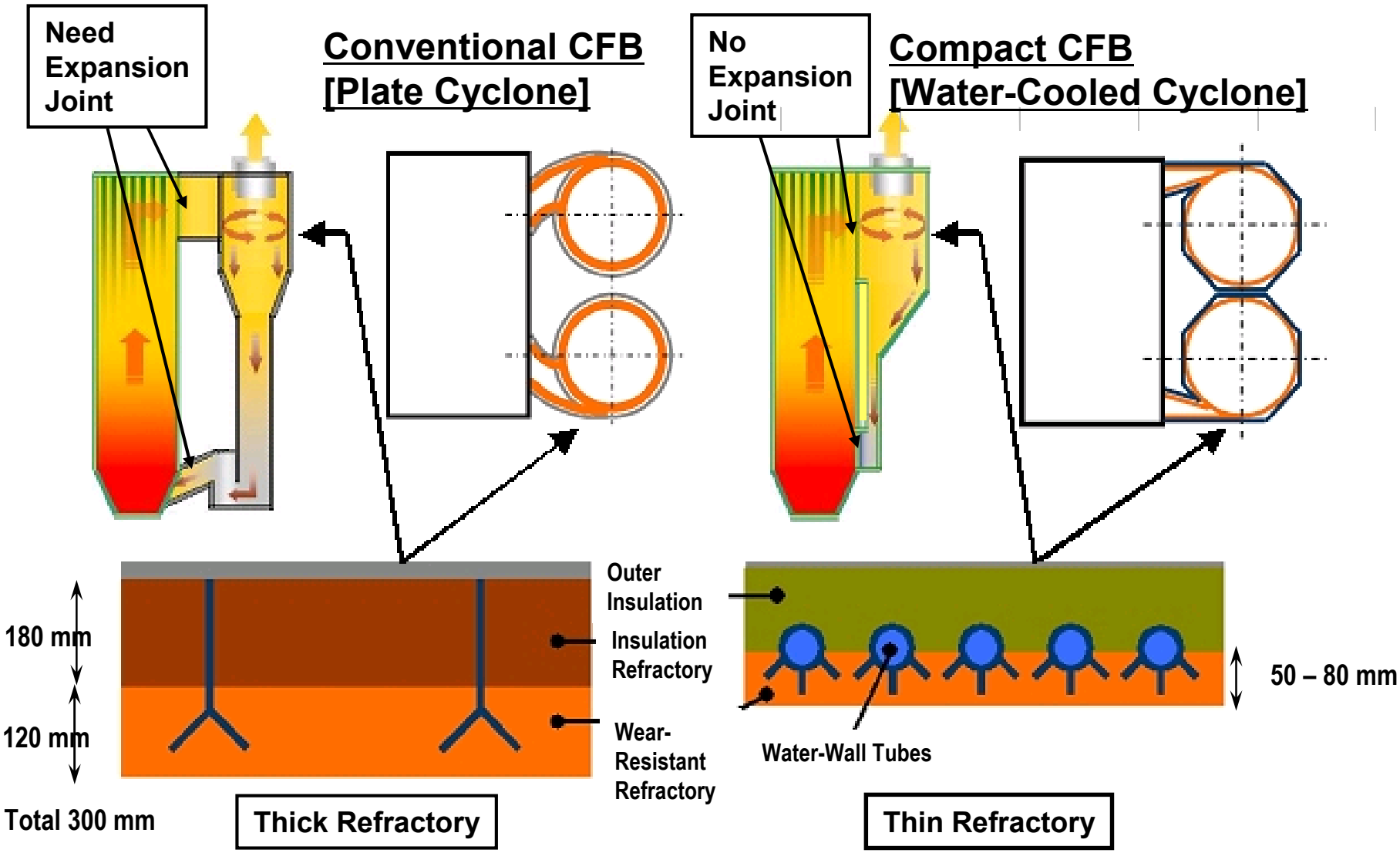
Old Technology
(originated by Ahlstrom)

Sumitomo
= [WATER-COOLED CYCLONE]



Advanced Technology
(developed by Foster Wheeler and licensed to Sumitomo)

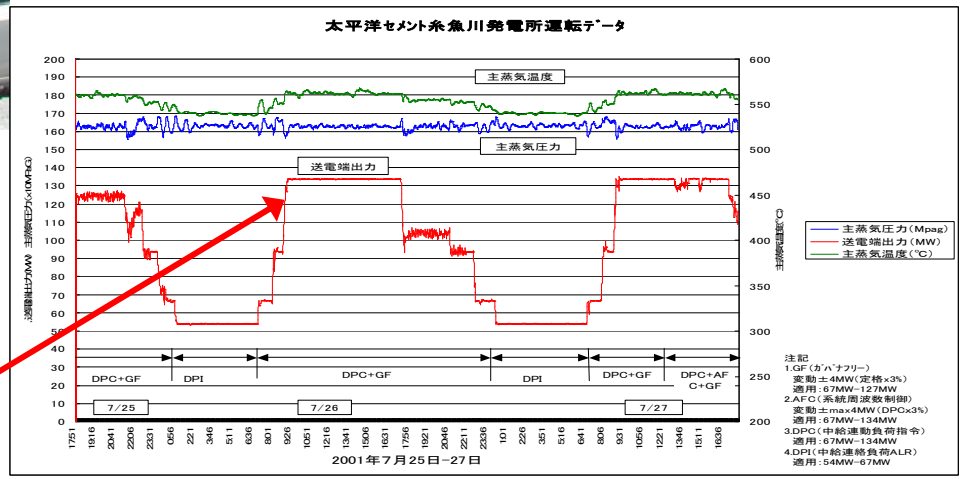
Water-Cooled Cyclone



5. Track records

149 MWe Coal-Fired CFB –Reheat unit
J-Power/Taiheiyo Cement, Itoigawa, Japan

Start-up	July 2001
Steam Flow	475 t/h
Steam Pressure	17 MPa
Steam Temperature	569/541 ℃
Power Output	149 MWe
Fuel	Semi-Anthracite
Emission SO_2	90 ppm(6%O_2)
NOx	120 ppm(6%O_2)
Service	IPP
Gross Plant Efficiency	42.8 %(LHV)



<Outstanding Features>

1. 1st large CFB with reheat in Japan
2. 40% to 100% daily swing operation

149 MWe Coal-Fired CFB –Reheat unit
J-Power/Taiheiyo Cement, Itoigawa, Japan

All of actual performances find everything satisfactory

Guaranteed items		Guarantee value	Actual performance	Notes
Boiler efficiency	%-LHV	91.6	91.6-92.1	Calc. code : JIS
Gross plant efficiency	%-LHV	42.8	43.3-43.5	
NOx emission	ppm	Less than 120	61-73	6%O_2-dry basis
SO_2 emission	ppm	Less than 90	59-64	6%O_2-dry basis
Dust in flue gas	mg/Nm^3	Less than 30	2-7	
Cold start	hours	Less than 12	12	After 50 hours or later from shut down
Warm start	hours	Less than 8	7.5	Before 50 hours or less from shut down
Load change rate	%/min	±2	±2	50-75-100 %MCR

205 t/h x 2 Lignite-Fired CFB
VND-PROJECT, Vietnam

Steam flow		2 x 205 t/h
Steam press.		13 MPa
Steam temp.		540 ℃
Power Output		**56 MWe x 2units**
Fuel		Lignite Ash(30%), S(6%) T.M.(19%)
Emission	SO_2	<191 ppm(6%O_2)
	NOx	<490 ppm(6%O_2)

<Outstanding Features>

- First CFB Boiler operated in Vietnam
- First coal-fired IPP project in Vietnam
- First power business by VINACOAL
- Minemouth project using high ash(30%), high sulfur(6%) lignite

TUAS POWER LTD, Singapore

3 x 450t/h CFB

Crushed PKS

Unit 1 had successfully achieved 100% load at first trial in January 2013.

<Outstanding Features>
- Singapore's first Coal fired Power Plant

Start-up	Unit 1 April 2013 Unit 2 November 2013 Unit 3 (not decided yet)
Steam Flow	3 x 450 t/h
Steam Pressure	10.5 MPa
Steam Temperature	510 ° C
Fuel	Indonesian Low Rank Coal PKS Max20%
Service	Co-Generation

Nippon Daishowa Paperboard, Otake, Japan

280t/h , Coal/ Sludge CFB

Start-up		April 2009
Steam Flow		280 t/h
Steam Pressure		10.3 MPa
Steam Temp.		535 ° C
Boiler Efficiency		90.3%
Power Output		30 MWe + 18 MWe
Fuel	99%	Indonesian Satui Coal
	1%	Paper Sludge
Emission SO_2		30 ppm$_{(6\% O_2)}$
NOx		80 ppm$_{(6\% O_2)}$
Dust		30 mg/m3N$_{(6\% O_2)}$
Service		Cogeneration

<Coal Comparison Information>

	Carbon	Volatile	Ash	S	HHV
Satui Coal	43.8%	45%	11.1%	0.85%	25.2MJ/kg
Berau Coal	50.5%	44%	5.5%	0.64%	25MJ/Kg

<Outstanding Features>

1. CFB firing Coal
2. Special Design for Coal 1) Furnace Bottom Kick-out Tube Design
   2) Compact Separator (Water-Cooled Cyclone)