DAIRY INDUSTRY –ENERGY CONSERVATION OPPORTUNITIES

First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

Spirax-Sarco-Head Quarters-Cheltenham

Spirax Sarco provides the steam **expertise** and **solutions** that can help the Industry meet its **sustainability goals** worldwide through the control and efficient use of steam, water and other industrial fluids.

The India journey

~~Spirax Marshall~~

March ‘2015

spirax sarco

- Have operated in India for over 55 years through a joint venture company
- A dominant supply position with significant market share in steam
- A very well known and respected brand

Investing for growth

Spirax-Sarco India

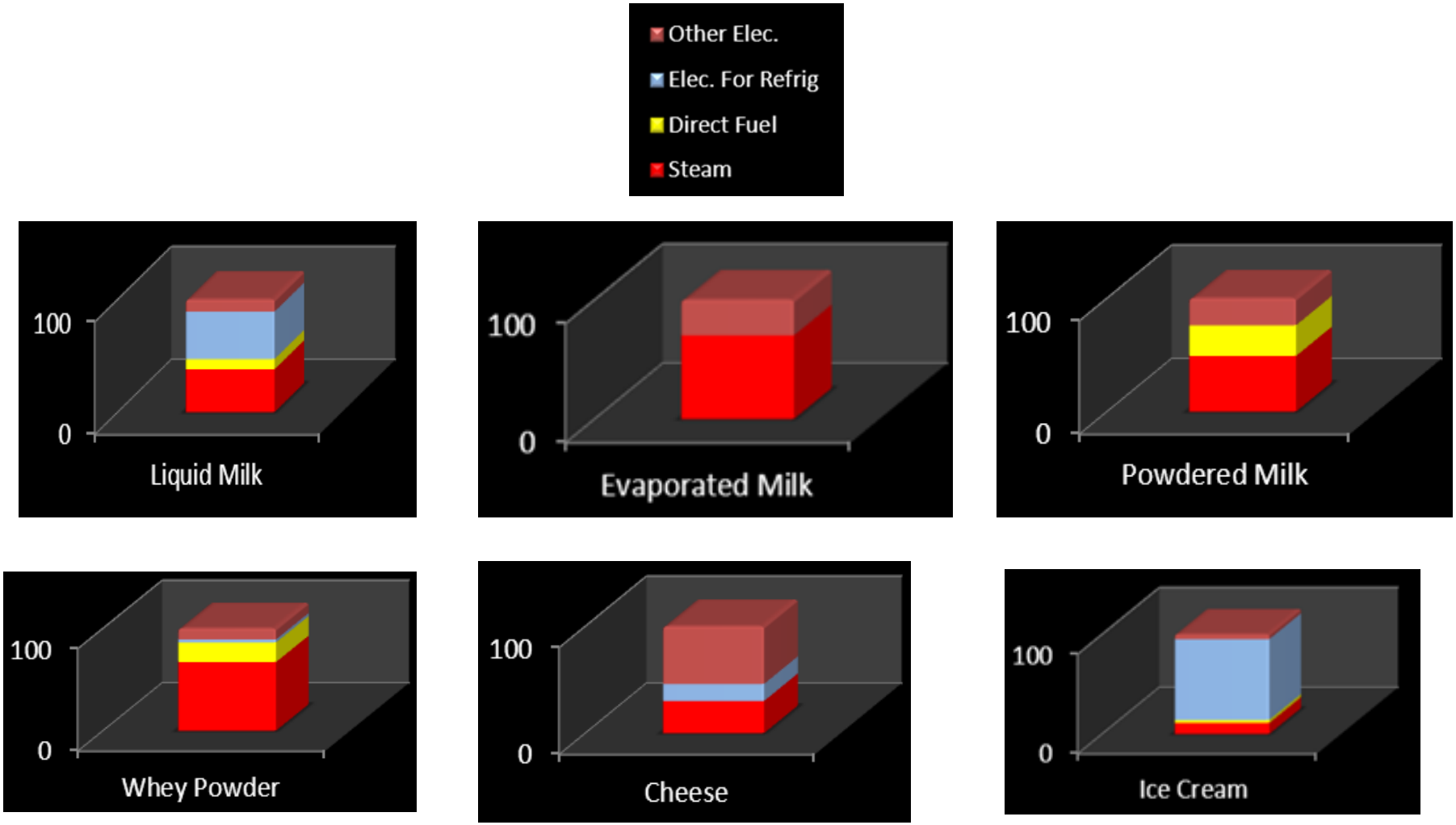
- £ 11 Million investment
- Headquarters in Chennai, offices in Mumbai, Delhi, Kolkata and Baroda.
- 53 high calibre people
- Sales HO, Manufacturing, Steam Technology centre and Warehouse – all operational

Spirax-Sarco India

Dairy Industry Benchmarks – By Product

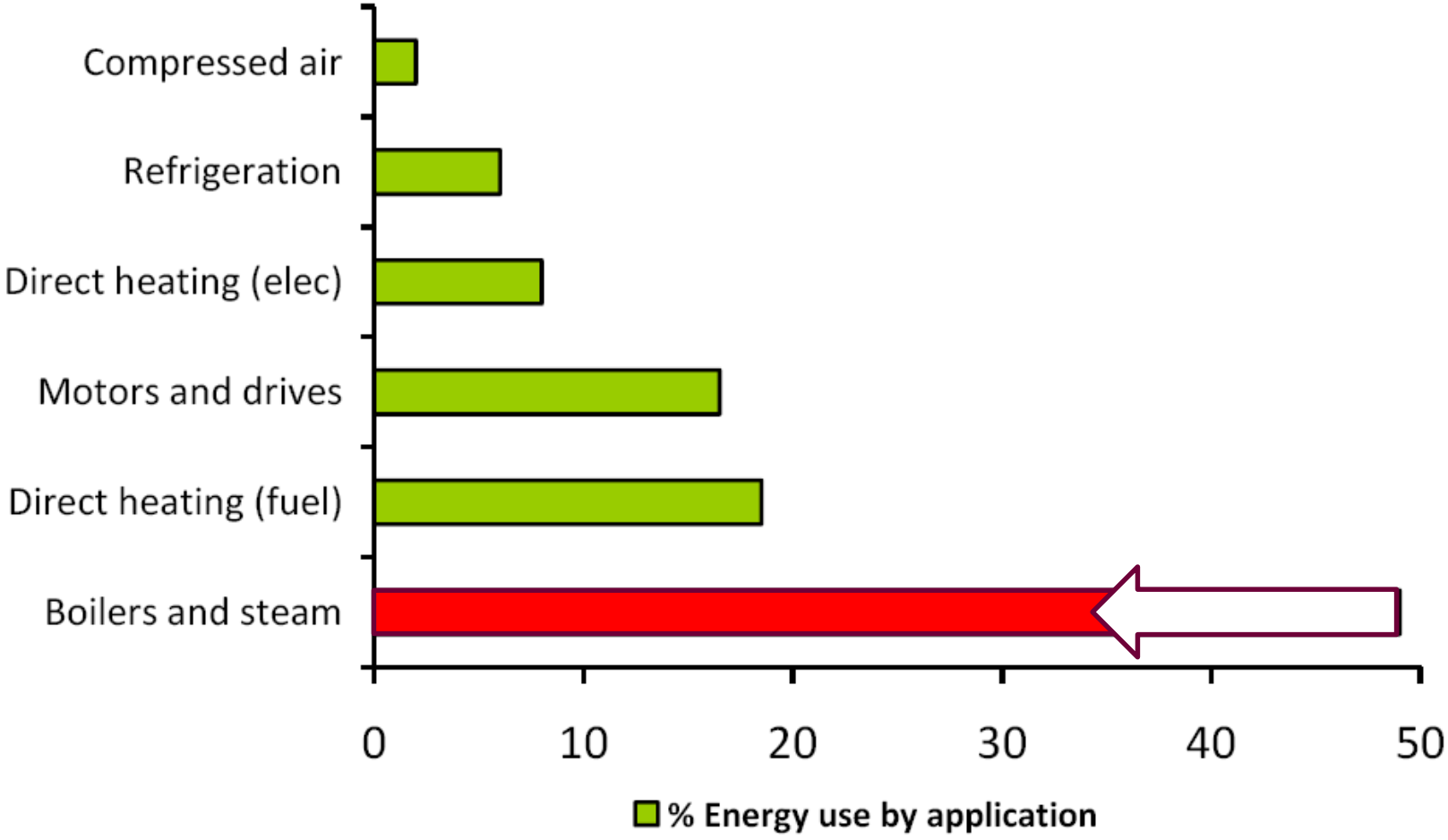
Table 3. Resource and energy consumption.							
Inputs per unit of product	Mass load unit	European dairies[a]	Swedish dairies[b]	Danish dairies[b]	Finnish dairies[b]	Norwegian dairies[b]	Industry benchmark[c]
Water							
Market milk and cultured products	L/L processed milk		0.96–2.8	0.60–0.97	1.2–2.9	4.1	1.0–1.5
Cheese and whey	L/L processed milk		2.0–2.5	1.2–1.7	2.0–3.1	2.5–3.8	1.4–2.0
Milk powder, cheese, and (or) liquid products	L/L processed milk		1.7–4.0	0.69–1.9	1.4–4.6	4.6–6.3	0.8–1.7
Ice cream	L/kg icecream						4.0–5.0
Energy							
Market milk and cultured products	kWh/L processed milk	0.09–1.11	0.11–0.34	0.07–0.09	0.16–0.28	0.45	0.1–0.2
Cheese and whey	kWh/L processed milk	0.06–2.08	0.15–0.34	0.12–0.18	0.27–0.82	0.21	0.2–0.3
Milk powder, cheese, and (or) liquid products	kWh/L processed milk	0.85–6.47	0.18–0.65	0.30–0.71	0.28–0.92	0.29–0.34	0.3–0.4
Ice cream	KWh/kg ice cream		0.75–1.6				0.8–1.2
Wastewater discharge							
Market milk and cultured products	Liters/L processed milk		0.8–2.5	0.83–0.94	1.2–2.4	2.6	0.9–1.4
Cheese and whey	Liters/L processed milk		1.4–2.0	0.77–1.4	1.5–3.2	3.2	1.2–1.8
Milk powder, cheese, and (or) liquid products	liters/L processed milk		1.2–4.3	0.75–1.5	1.9–3.9	2.0–3.3	0.8–1.5
Ice cream	L/kg ice cream		2.7–4.4	-	5.6	3.0–7.8	2.7–4.0

Steam Consumptions by Process



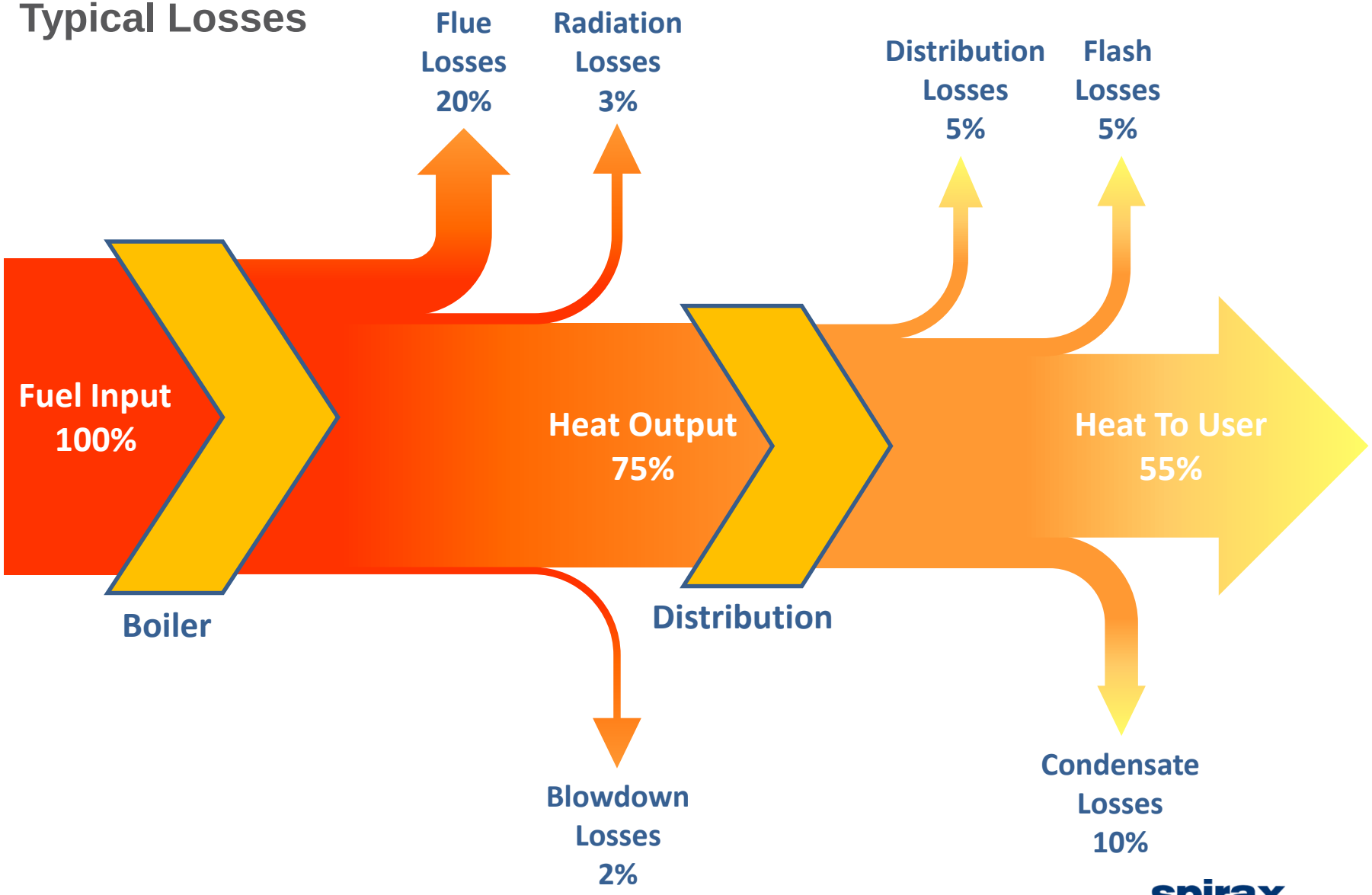
Typical Energy Split

Generic energy split for Dairy Industry



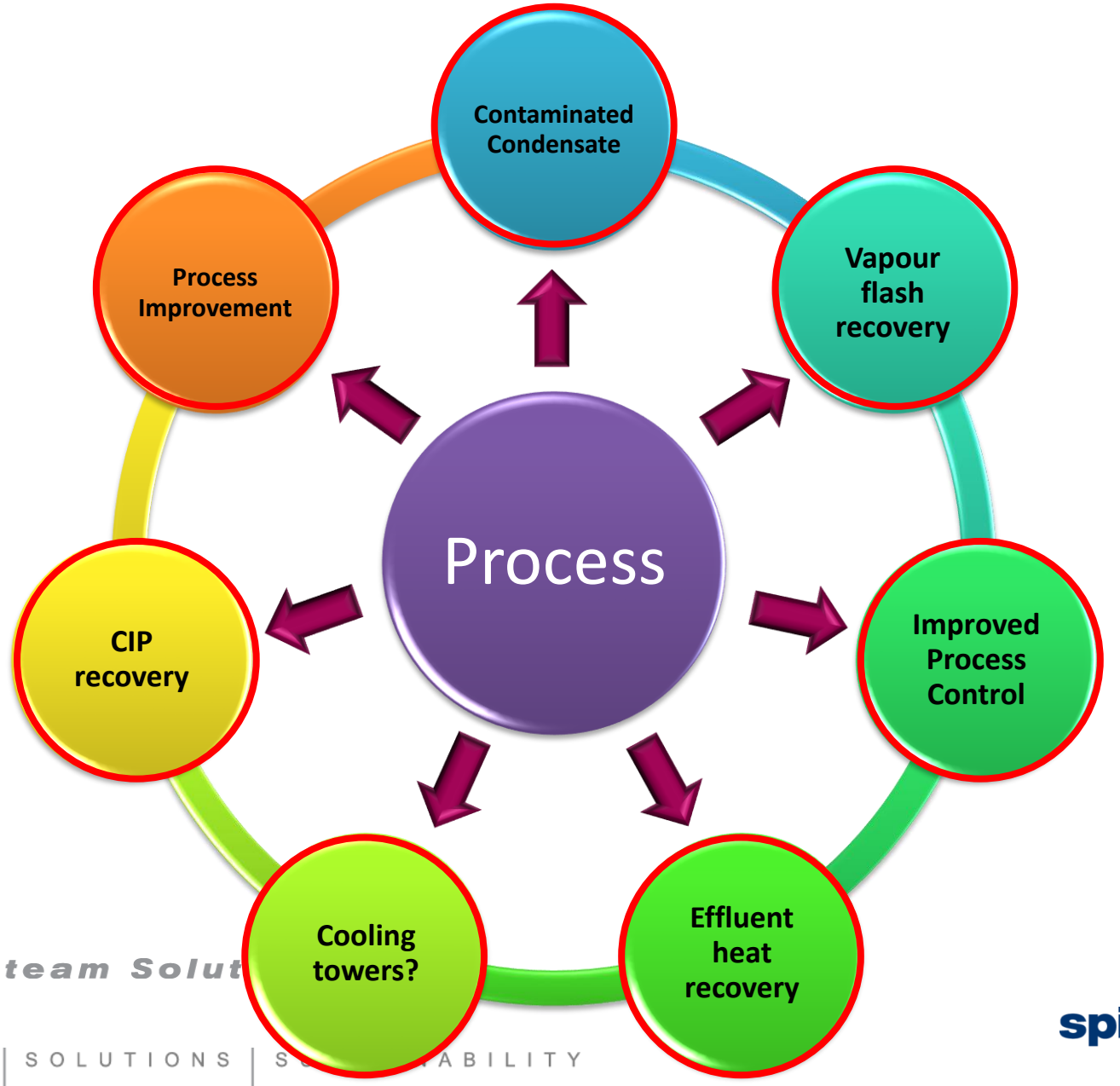
THE STEAM SYSTEM LOSSES

Typical Losses



spirax sarco

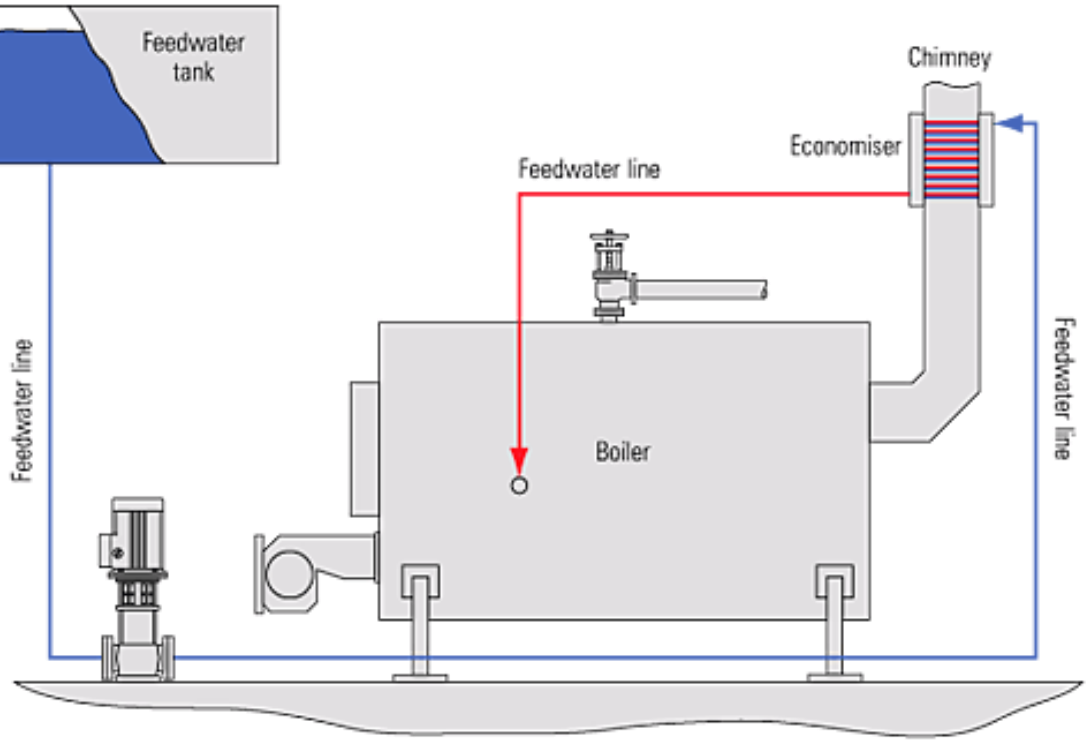
Process Heat Recovery



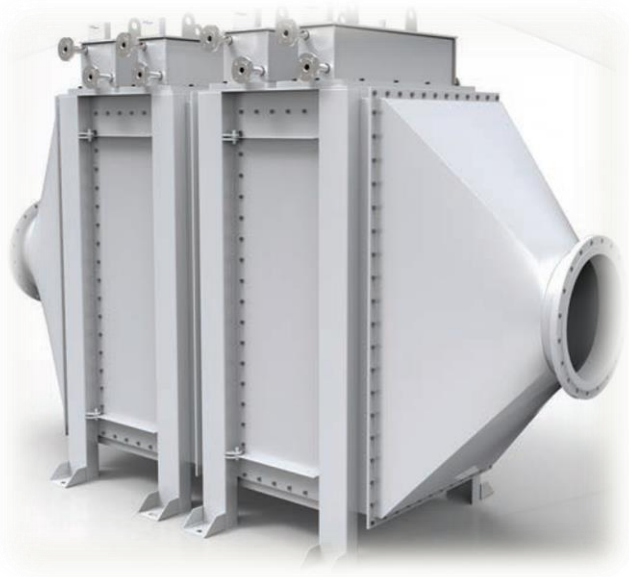
BOILER EFFICENCY

Economisers

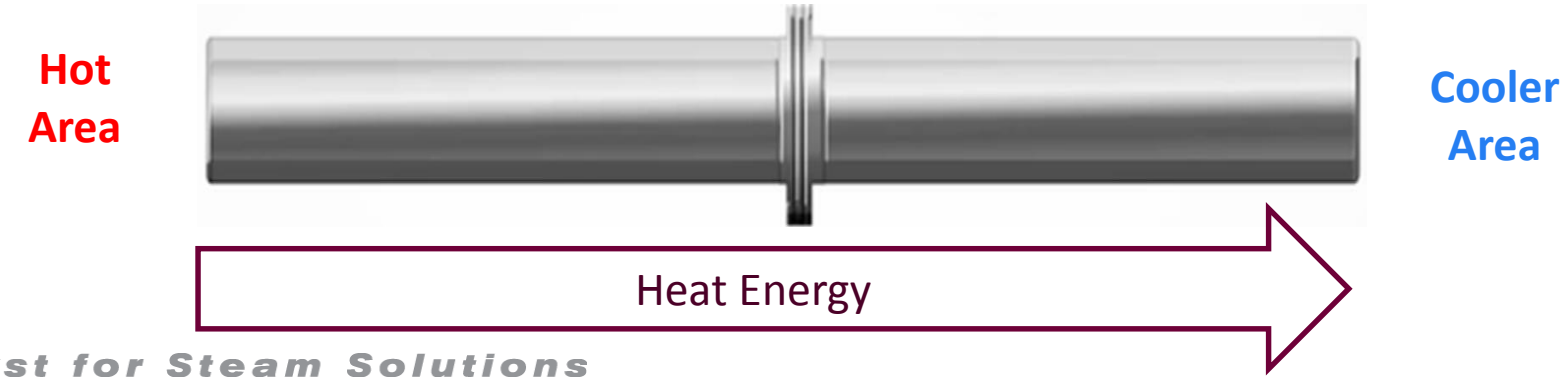
- Average savings of 3 to 5 % for gas/Oil fired boilers.



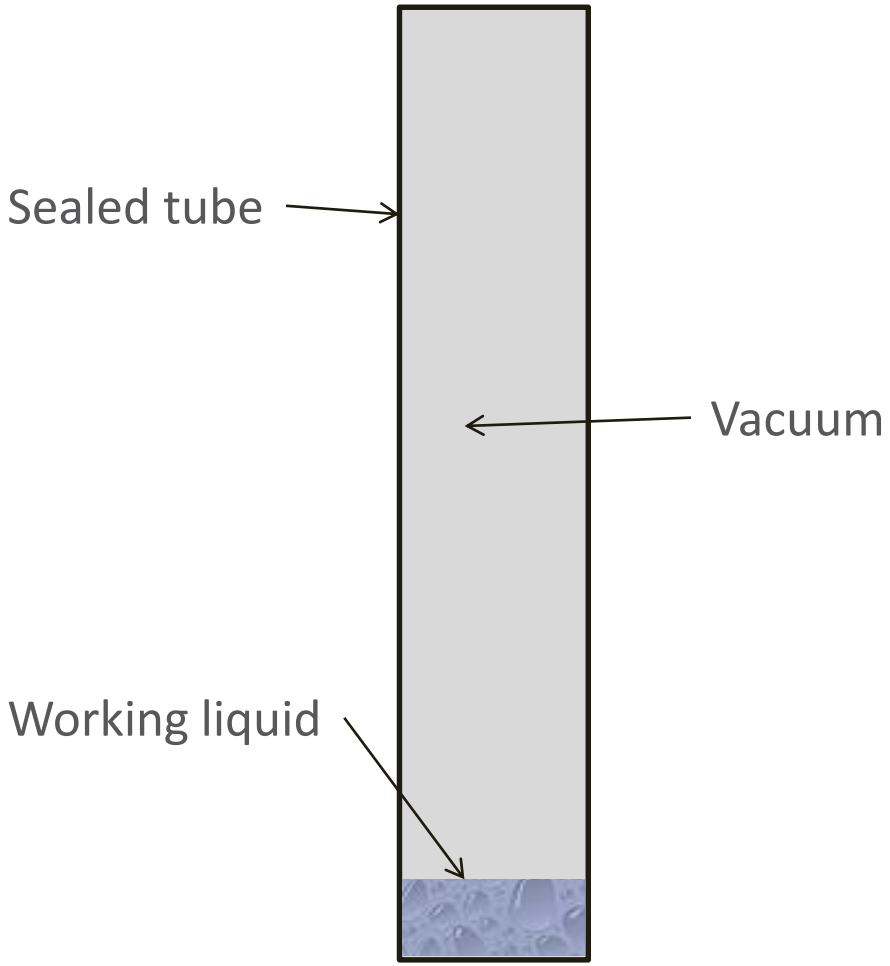
Heat Pipe Heat Exchangers



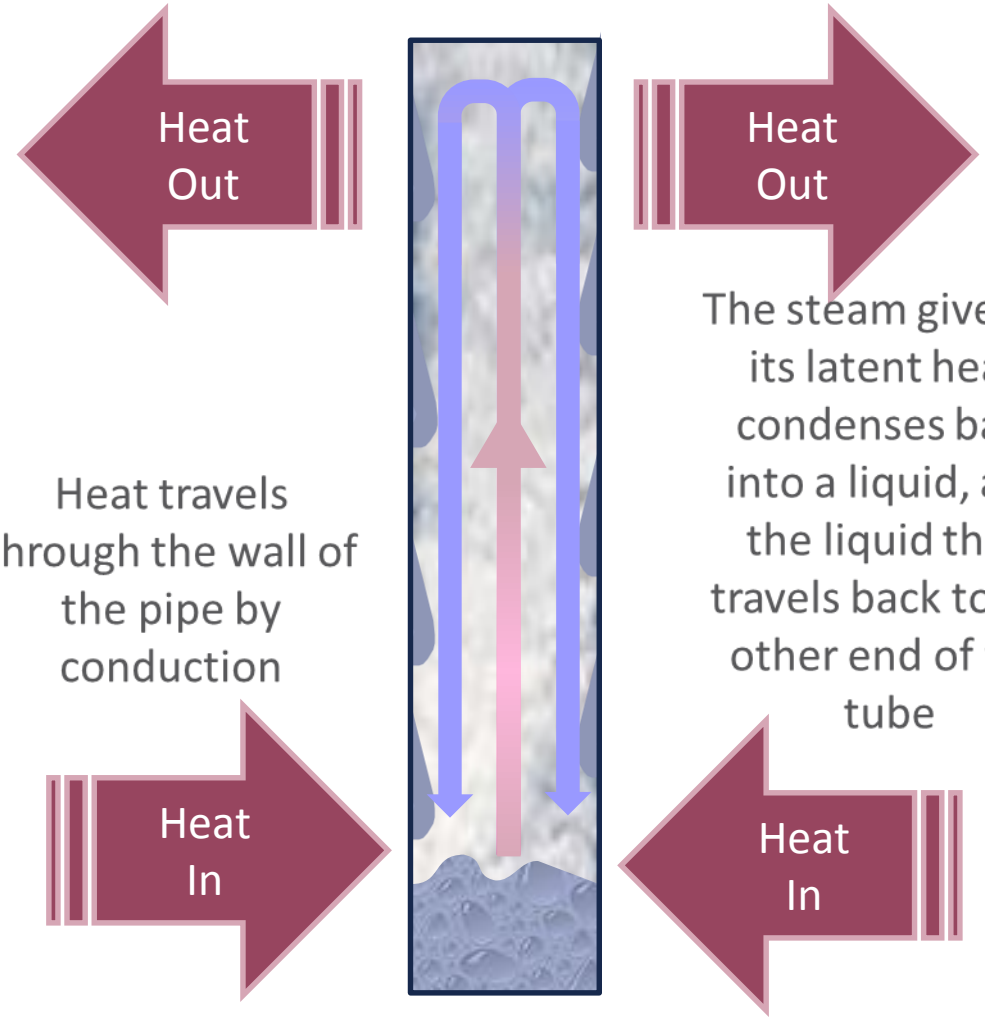
A heat pipe is a heat-transfer device that combines the principles of both thermal conductivity and phase transition to efficiently manage the transfer of heat energy from a hot area to a cooler area.



Heat Pipe Operation

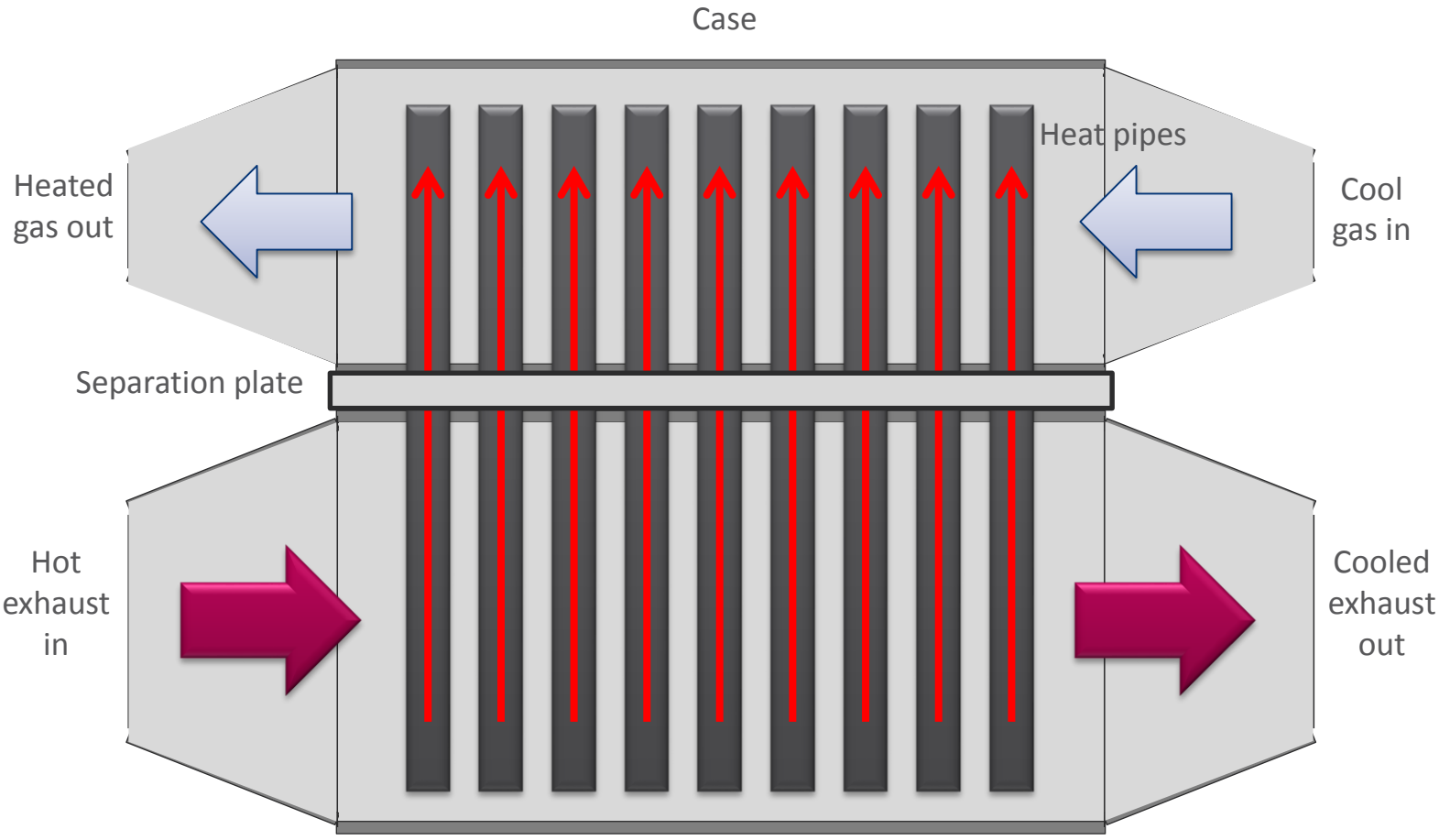


Heat Pipe Operation



As long as there is temperature differential between the evaporator end and the condenser end of the heat pipe, the process will continue

Heat Pipe Heat Exchanger (HPHE)



Advantages of a HPHE?

Multiple Redundancy

Each pipe operates independently so unit is not vulnerable to a single pipe failure

- This prevents cross contamination each heat pipe acts as an additional buffer between the two fluids

Low Fouling

Use of smooth pipes allows exchangers to be used in high particulate or oily applications

Ease of Cleaning & Maintenance

Can be maintained in situ (no uninstall)

Manual/automated cleaning systems

Isothermal Operation – no hot or cold spots

Eliminates cold corners and condensation

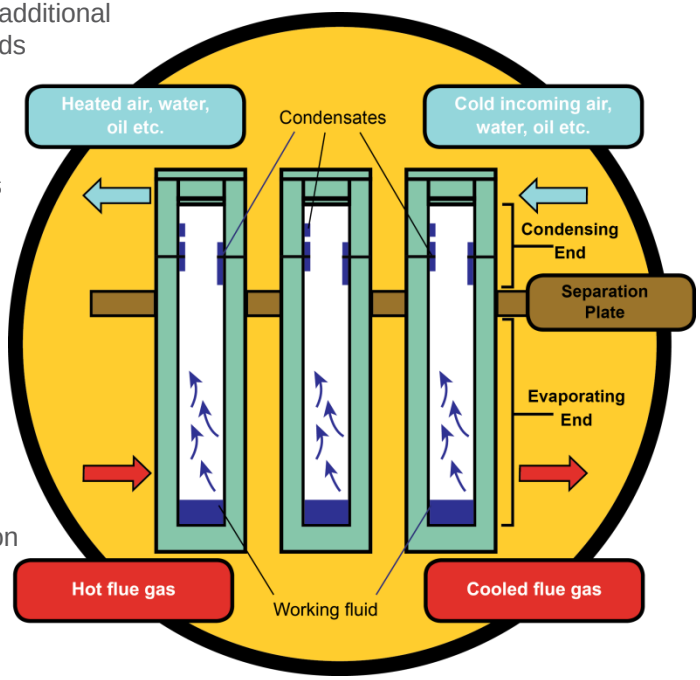
Allows greater energy recovery

Better longevity for thermal oil

Robust Materials and Long Life

Design allows pipes to freely expand and contract, thus no thermal stress on structure

Thick pipe walls resist erosion/corrosion



Intermediate Pipe Working Temperature

Allows higher exhaust temperature limits on some applications

Low Pressure Drop

Low parasitic load means less capital and running cost on fans and greater energy recovery possibilities

More efficient – usually smaller and/or lighter than conventional exchangers

Highly Scalable, Customisable & Configurable

Modular design allows on site assembly

Can be designed for future expansion, to meet specific application or operational needs

Reactivity

Fast reaction time, offers different control options and suitable for sensitive apparatus: does not require preheating

B850

Boilerhouse Energy Monitor

B850 - Is a flexible and easy to use Energy Monitor that accurately calculates the Direct Efficiency of energy transfer from fuel to steam and flow rates of feedwater, blowdown and condensate return on steam boiler applications.

Pre-configured software - B850 is compatible with all Spirax flowmeters and automated blowdown systems.

Ease of use – It's easily commissioned via a PC based wizard and USB

Communication protocols – Has the ability to link into many networks as standard

Data logging – Review your plant against past Performance

"THE B850 COMBINES FLEXIBILITY ALONGSIDE EASE OF USE"

First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

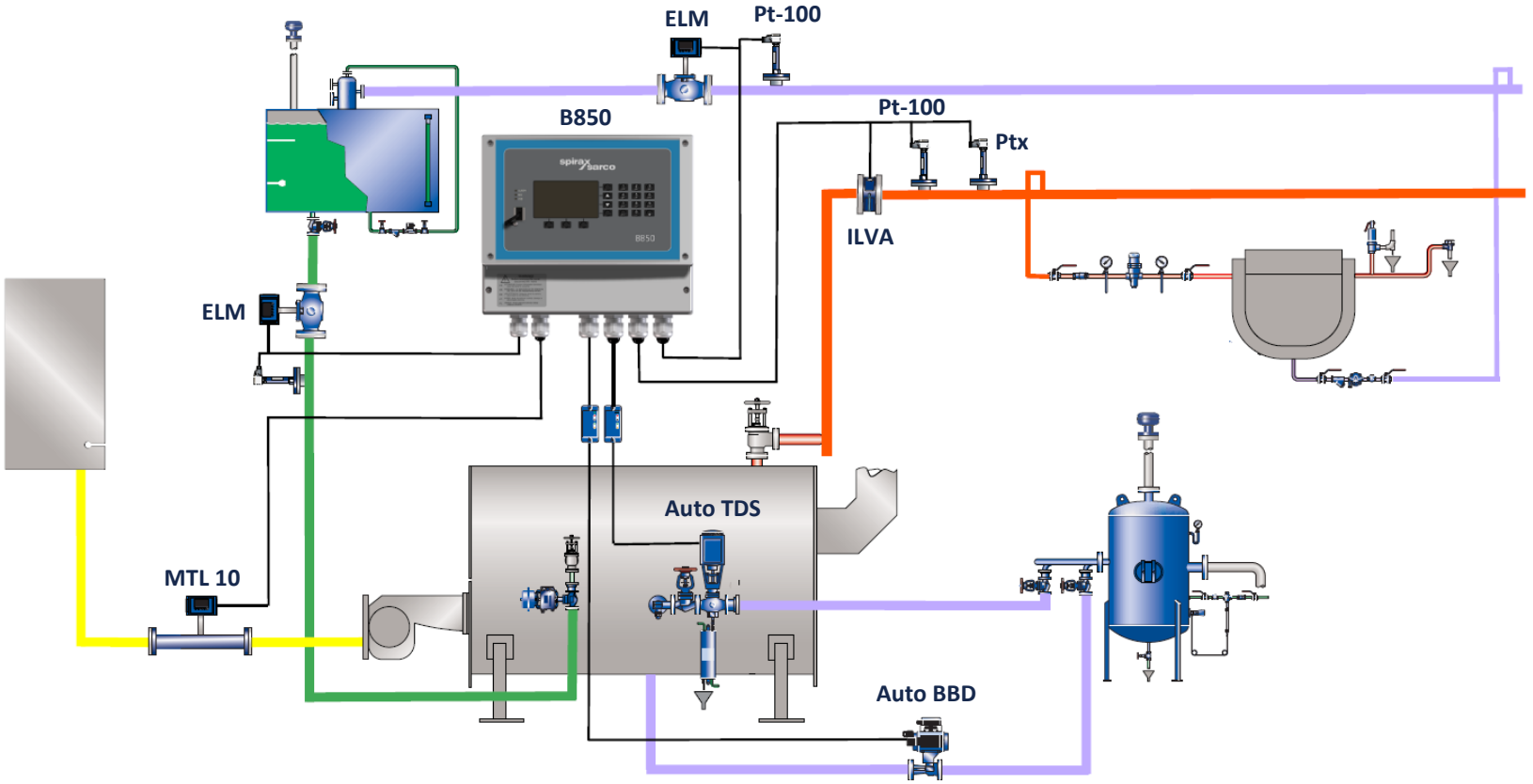
spirax sarco

B850

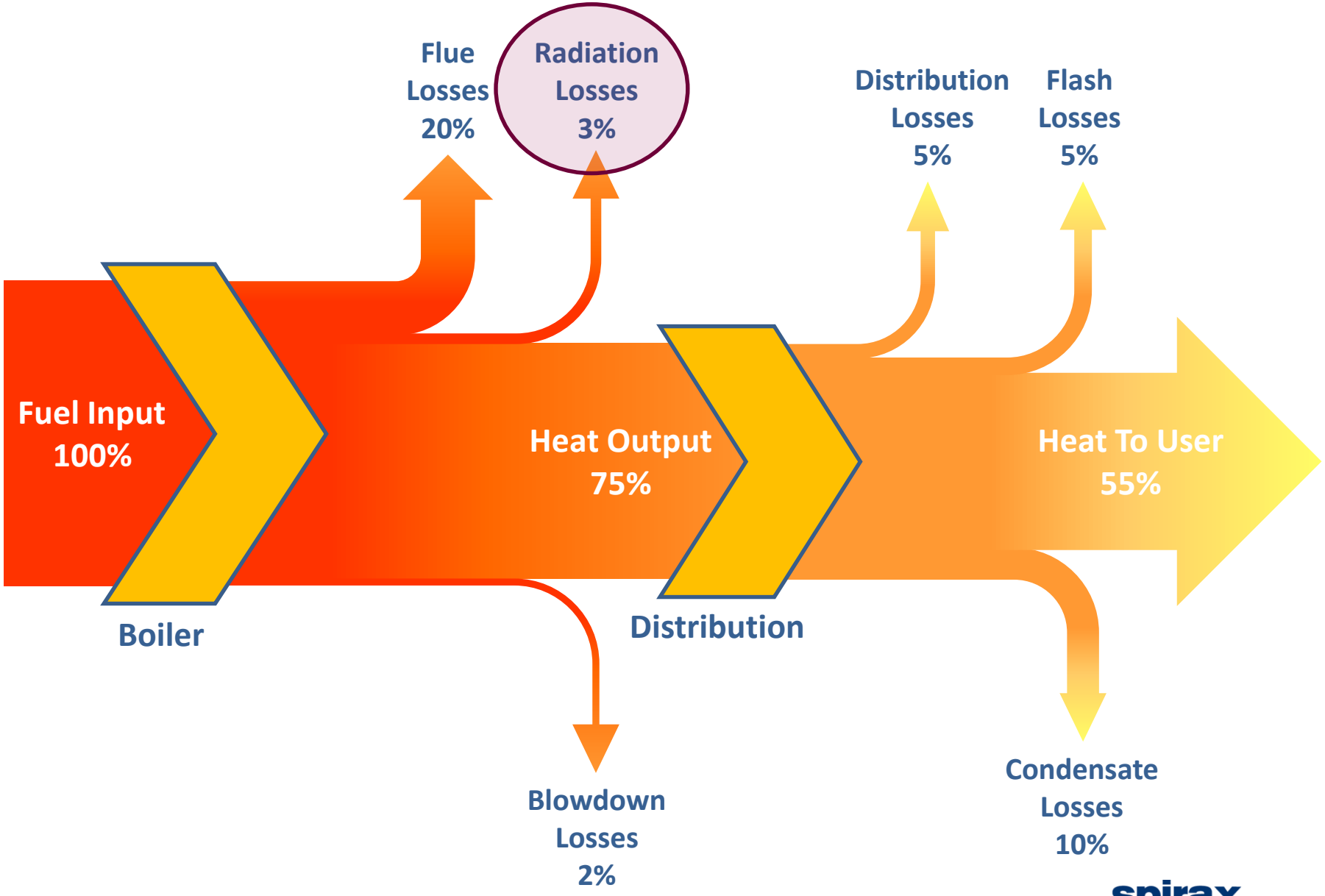
Boilerhouse Energy Monitor

> “GIVES YOU THE FLEXIBILITY YOU NEED WHEN MONITORING YOUR BOILERHOUSE EFFICIENCY”

The B850 is compatible with all Spirax Sarco flowmeters and automated blowdown systems associated with steam boilers.



THE STEAM SYSTEM LOSSES



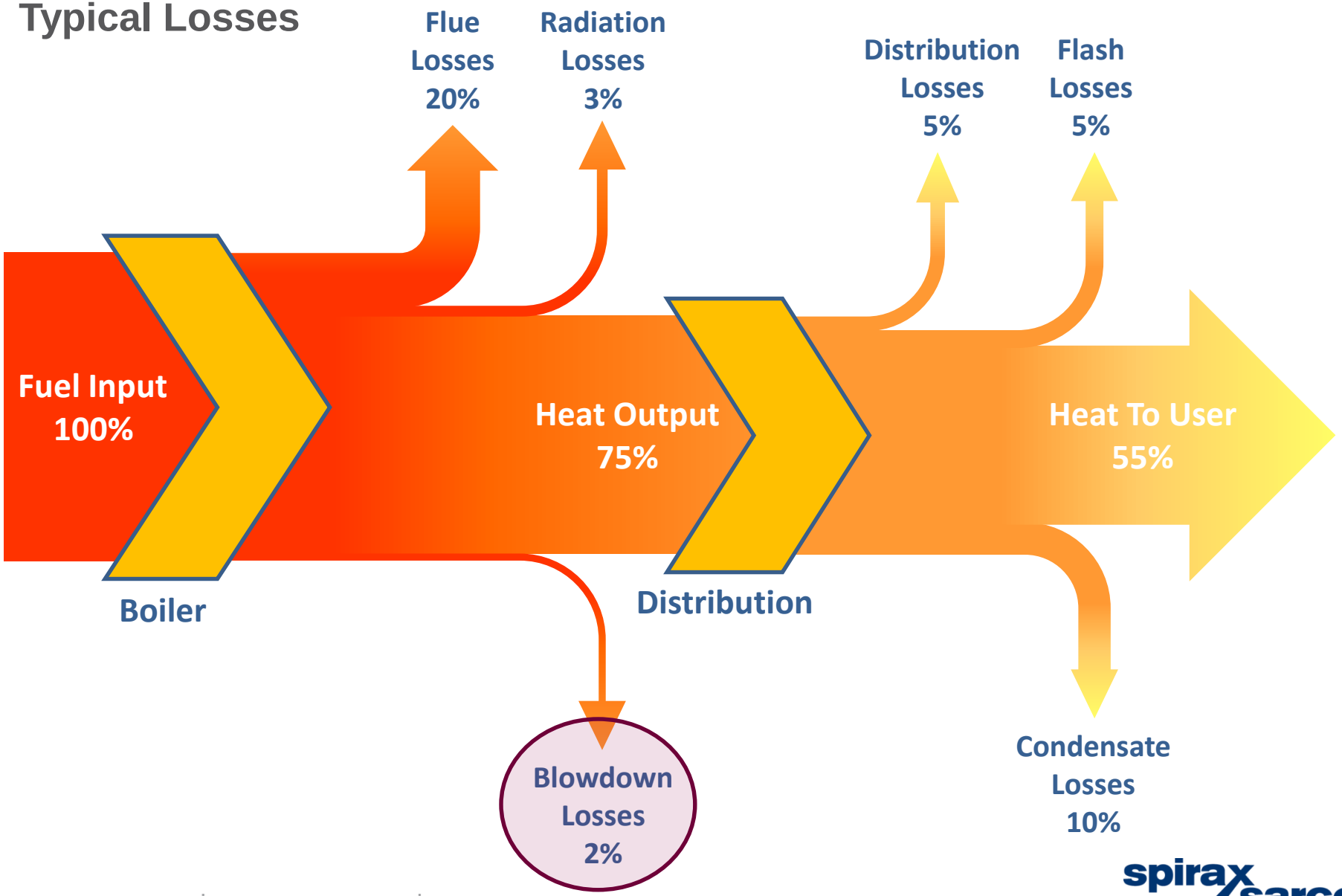
spirax sarco

BOILER EFFICENCY

Boiler Shell Heat Losses

THE STEAM SYSTEM LOSSES

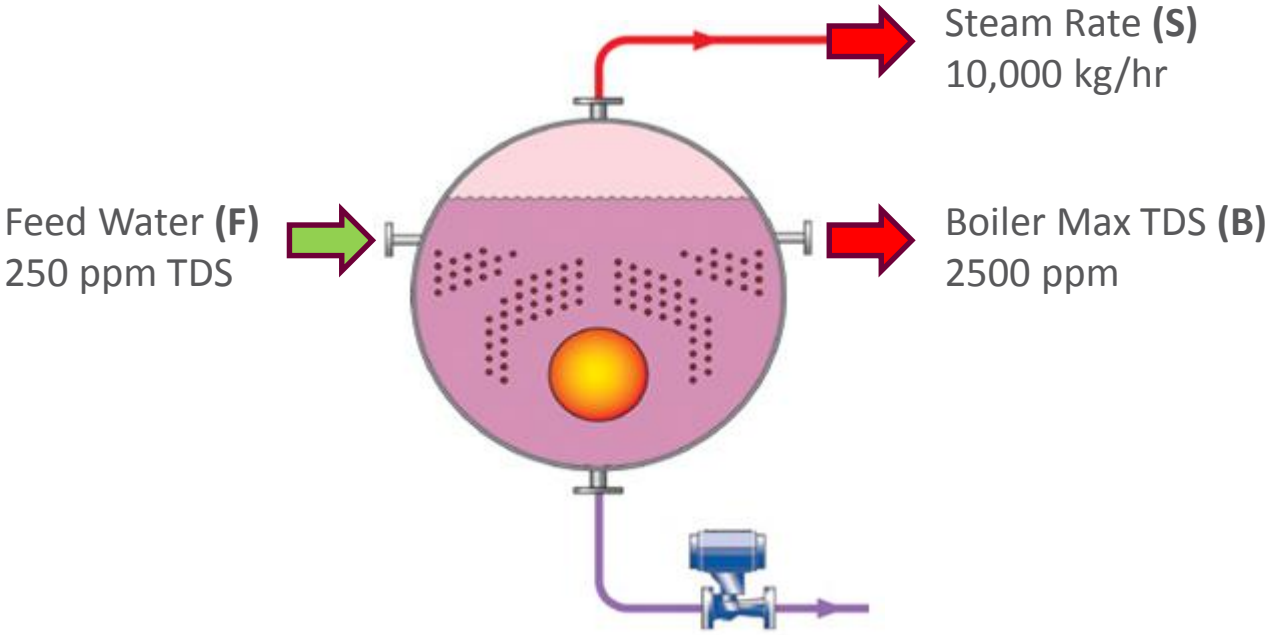
Typical Losses



spirax sarco

BOILER EFFICENCY

Blowdown Rate Calculation

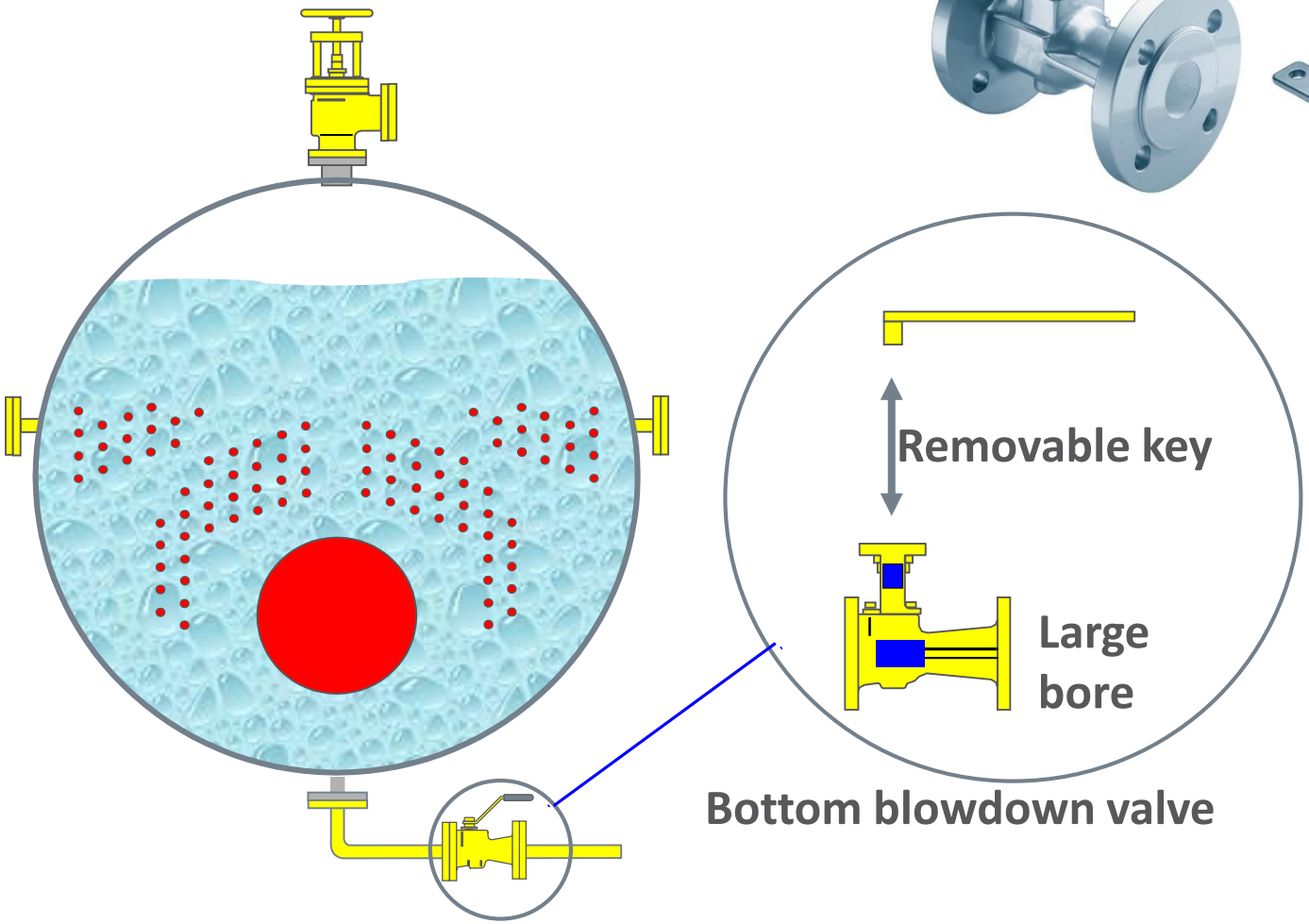


$$\text{Blowdown Rate} = \frac{F \times S}{B - F}$$

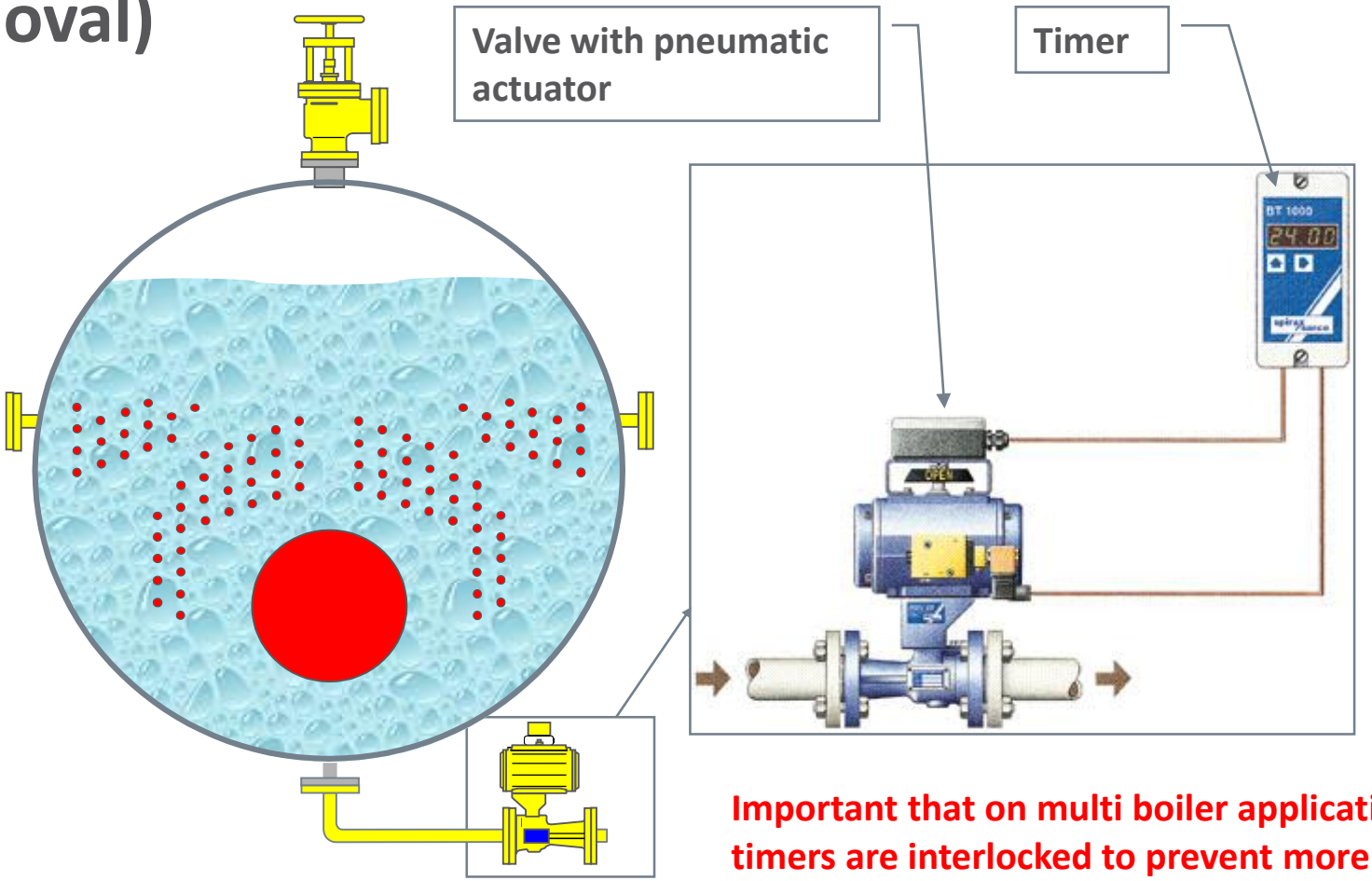
$$= \frac{250 \times 10000}{2500 - 250}$$

$$= 1111 \text{ kg/h or } 11\%$$

Manual bottom blowdown



Time controlled bottom blowdown (Sludge Removal)

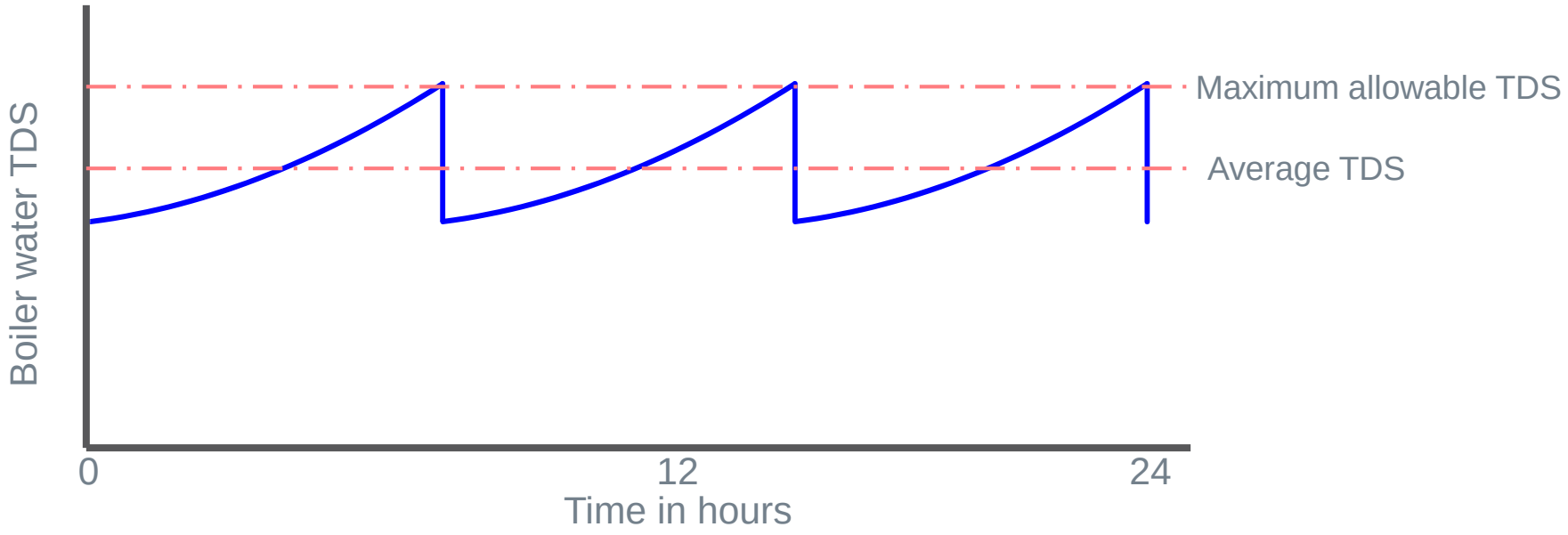


Important that on multi boiler applications, the timers are interlocked to prevent more than one boiler blowing down at one time.

Ensures blowdown is carried out regularly.
One less action for boiler attendant.

BOILER EFFICENCY

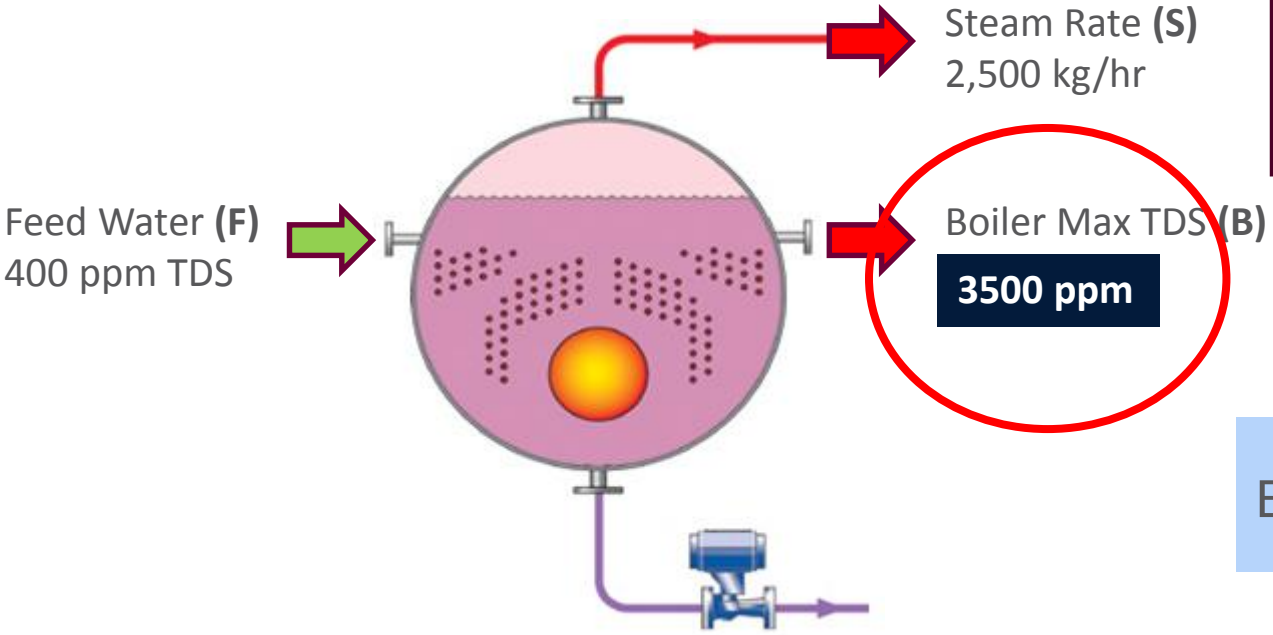
Manual Blowdown



- Manual blowdown creates high and low spikes
- Above max allowable levels scale forms
- Below acceptable levels there is an increase in waste water
- Due to spiking action levels are normally set lower so average TDS is low

  ∴ high waste water and energy

CASE STUDY



Operation: 8000 hrs / yr
Fuel Cost: 28 / litre
Water Cost: 150 / m³

$$\text{Blowdown Rate} = \frac{F \times S}{B - F}$$

$$= \frac{400 \times 2500}{3000 - 400}$$

= 384 kg/h or 15%

Boiler Pressure (barg)	% Fuel Saved for 1% Blowdown Reduction
7,0	0,19%
10,0	0,21%

0.3-0.4% Fuel Saving

$$= \frac{400 \times 2500}{3500 - 400}$$

= 322 kg/h or 13%

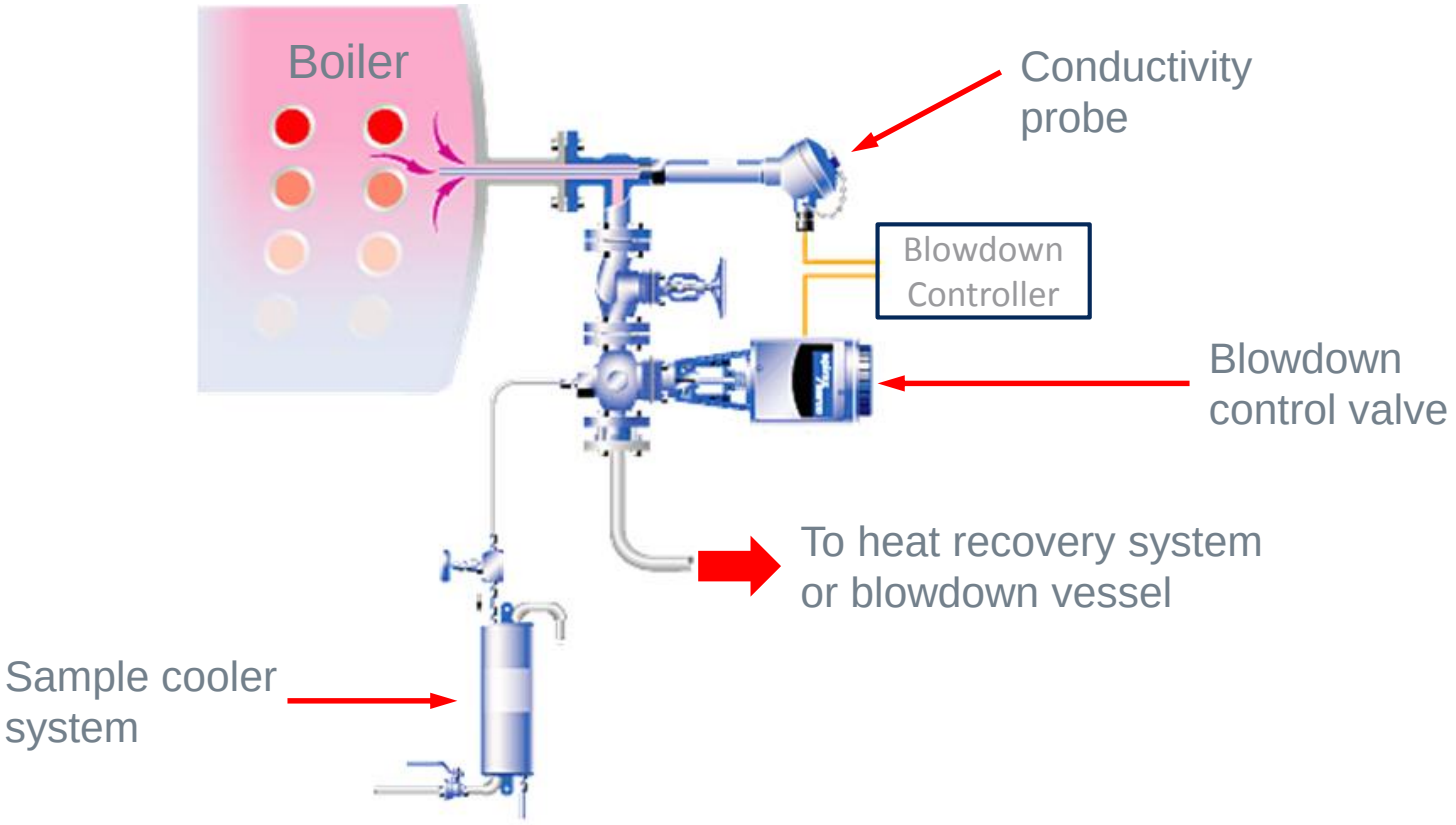
Water Saving

Cost of water = Rs 150/ m³
= 62 kg/h blowdown saving
= 8064 hours / yr
= Rs 75000 / yr

spirax sarco

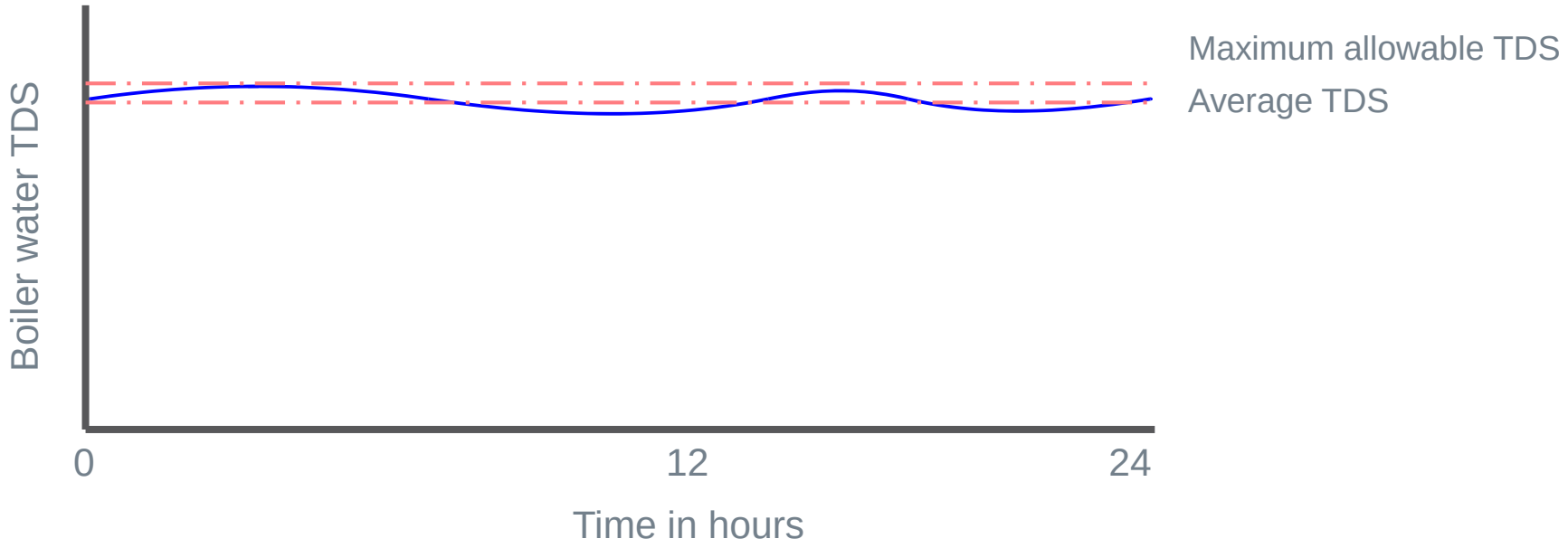
BOILER EFFICENCY

Automatic Blowdown Control System-TDS Control



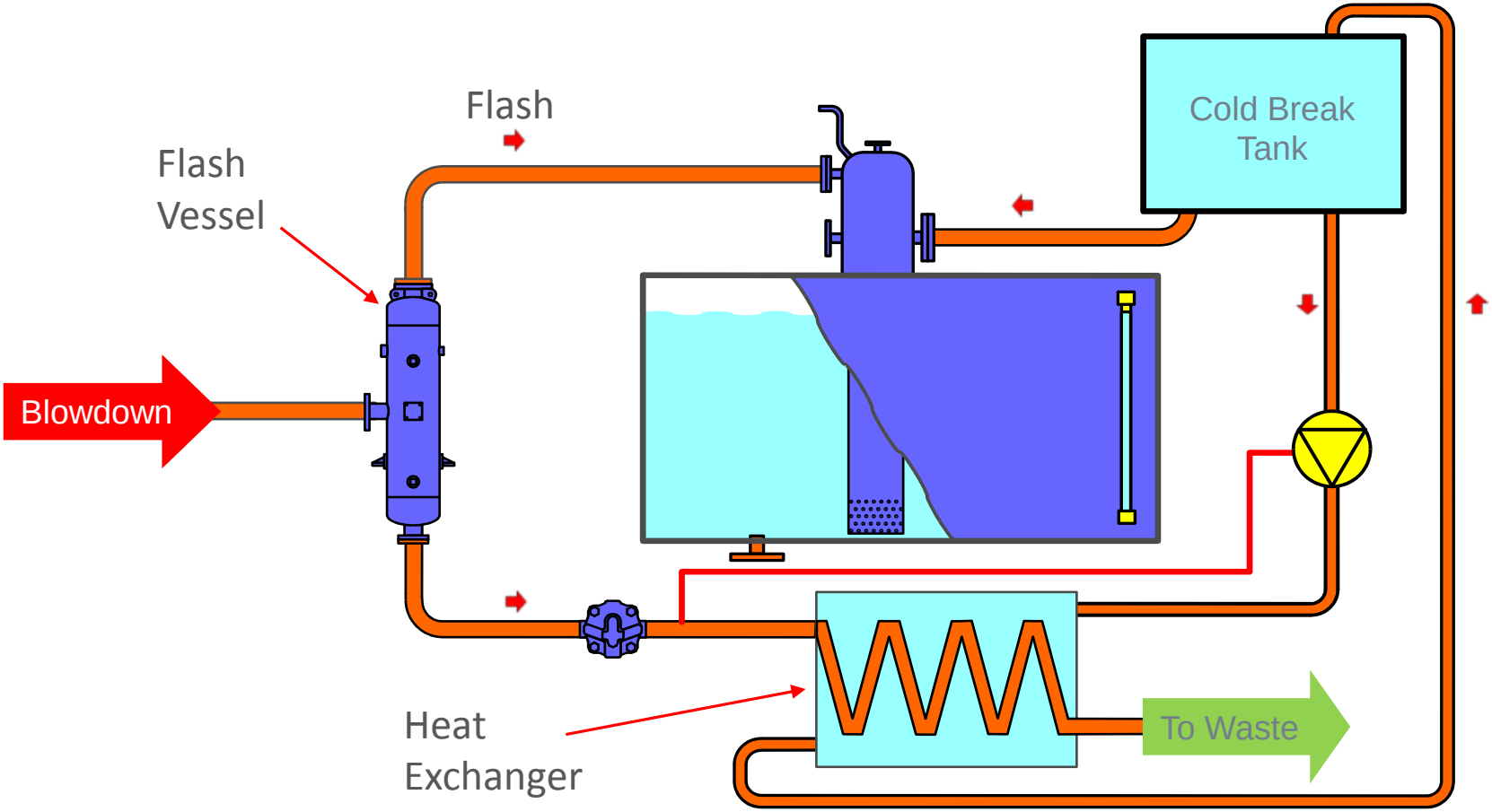
BOILER EFFICENCY

Automatic TDS Control

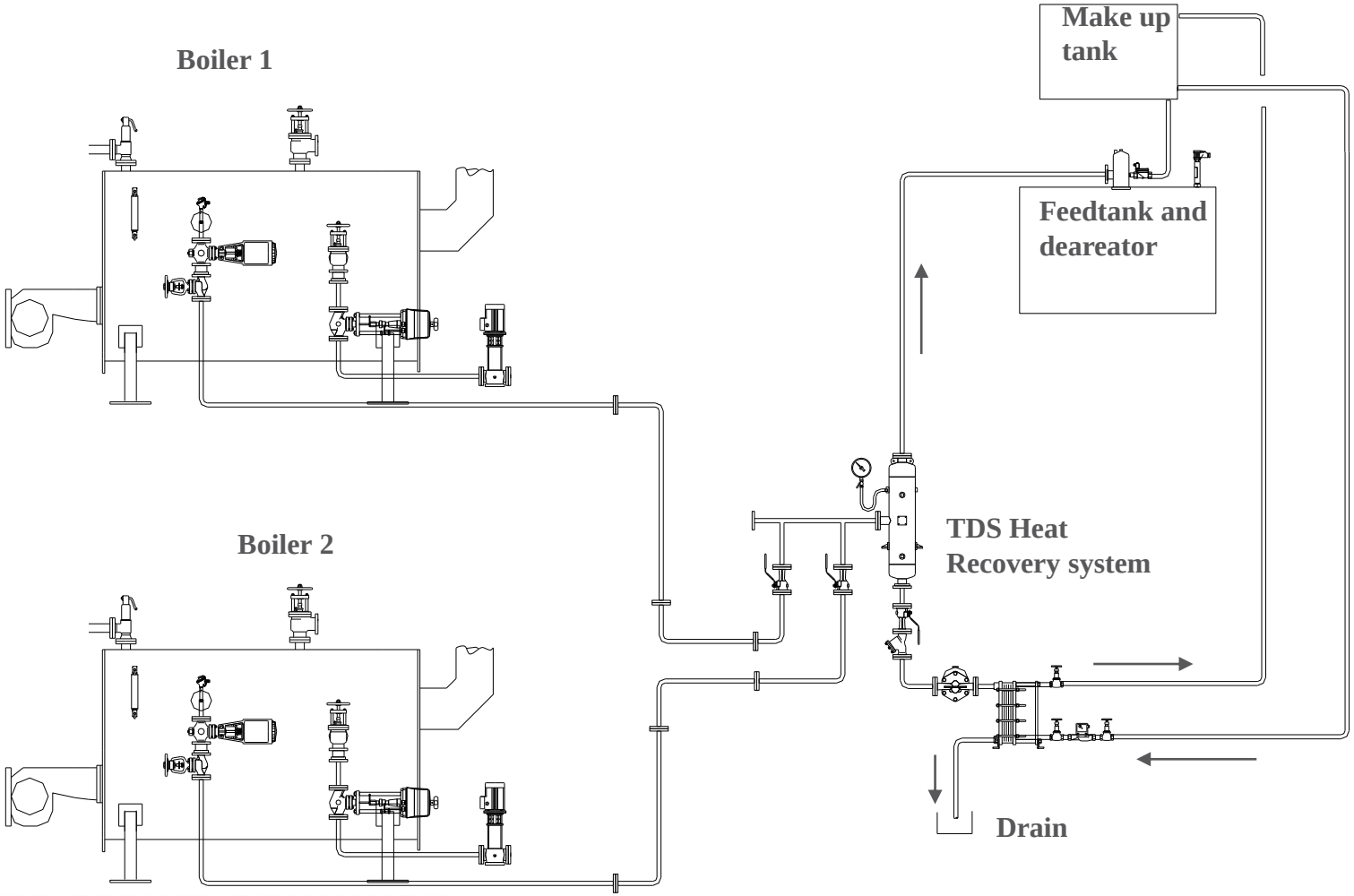


- Minimisation of blowdown rate: reduction in waste water, chemicals and energy loss
- Labour saving advantages from automation
- Closer control of boiler TDS levels
- Boiler maintained at design conditions
- Heat recovery savings
- Reduced maintenance issues

SCHEME FOR HEAT RECOVERY FROM BOILER BLOWDOWN



Blowdown Heat Recovery Package



CASE STUDY

Savings	
Fuel from flash recovery	Rs 9,15,200
Blowdown Sensible heat	Rs 1,88,160
Water savings	Rs 62,400
Total Savings	**Rs 11,65,760**

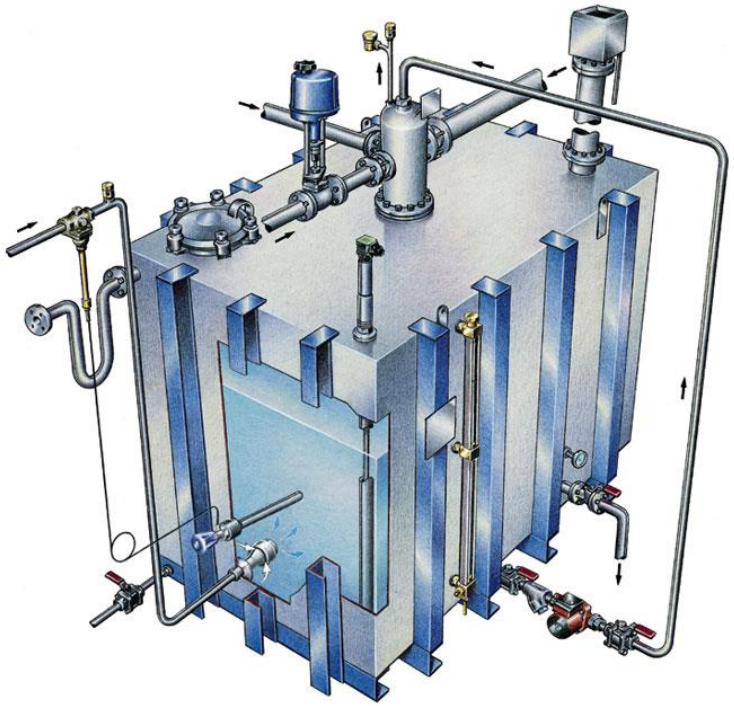
Investment Rs 6,00,000: <6 mth ROI *(conservative)*

Plus….
Water treatment savings
Waste water treatment savings
Chemical savings
Improvement in boiler efficiency – additional fuel savings

BOILER EFFICENCY

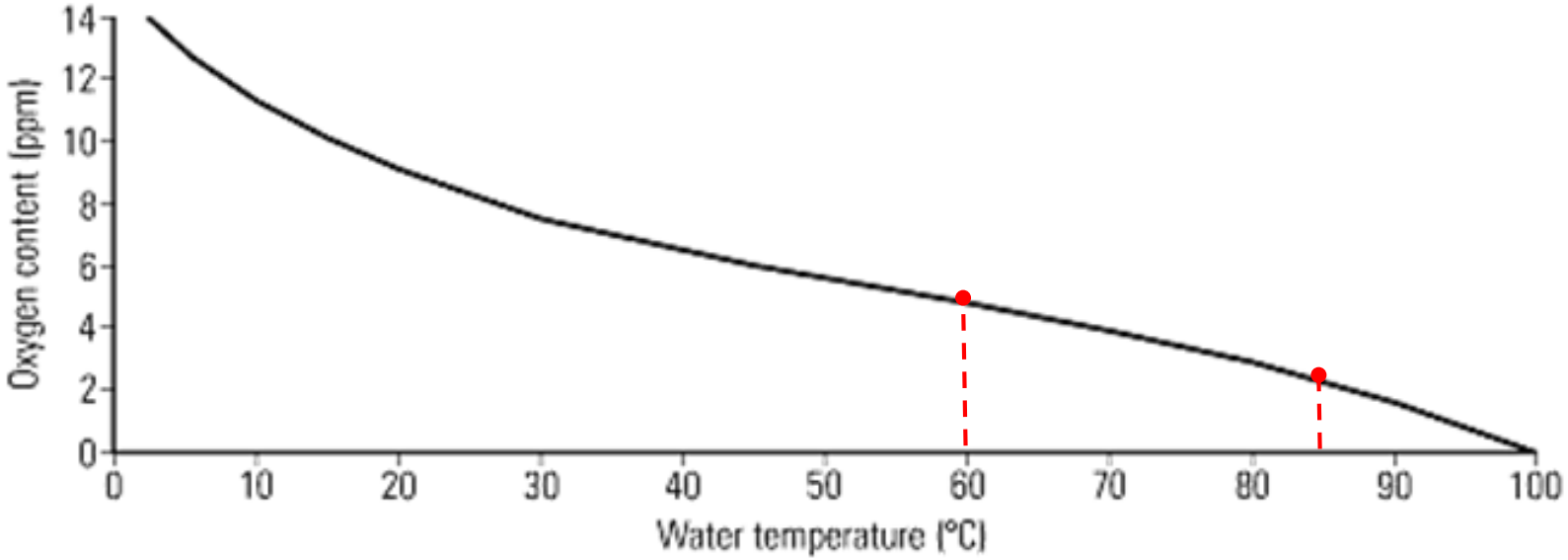
The Feedwater Tank

- For every 6°C rise in temperature equates to 1% reduction in fuel.
- 12°C rise equates to Rs10,00,000 for a Rs 500,00,000 annual fuel bill
- Reduces oxygen content
- Reduces chemicals
- Increases boiler efficiency



Pre heating the feedtank

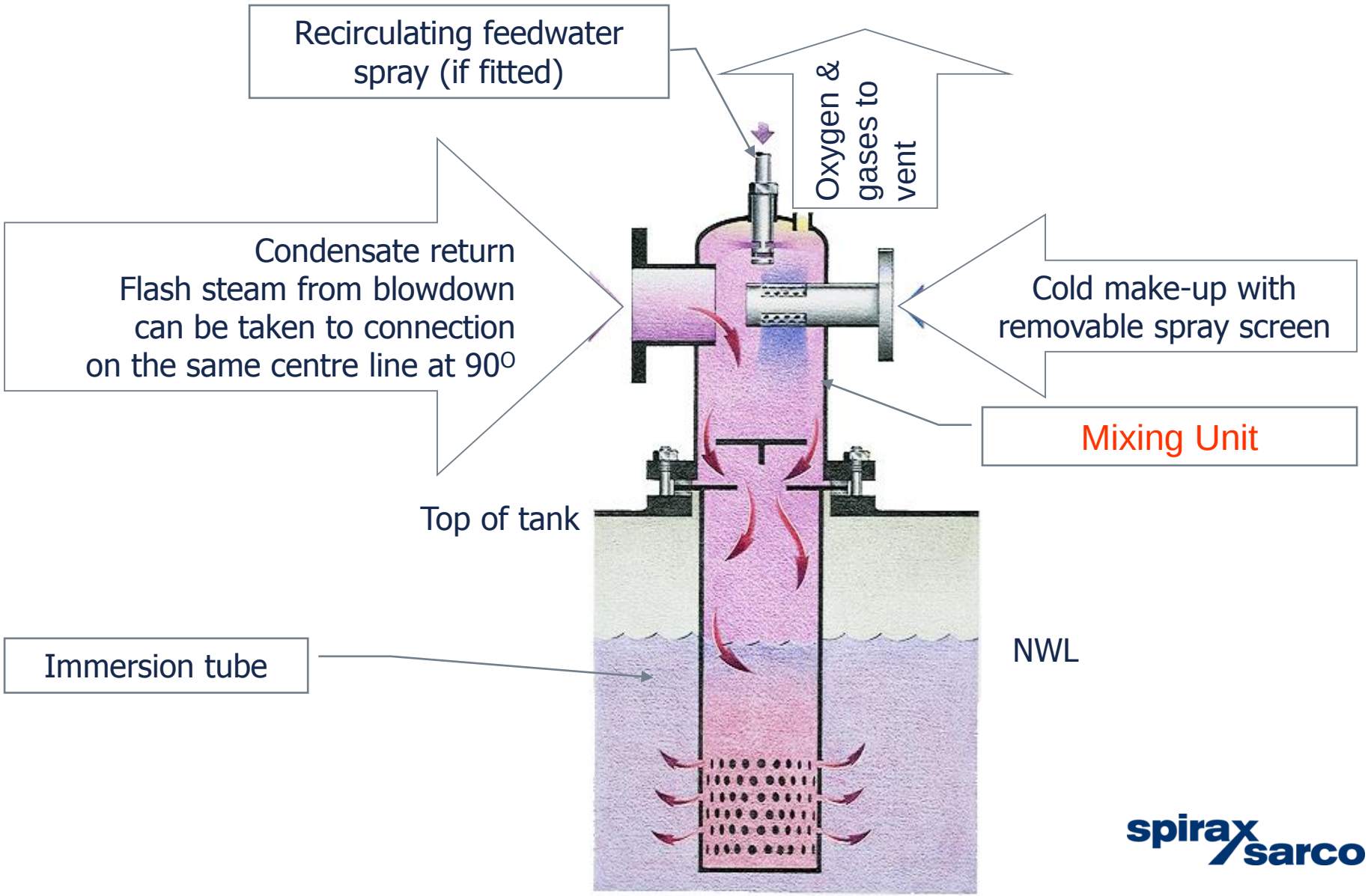
Impact of raising feedwater temperature on oxygen scavengers



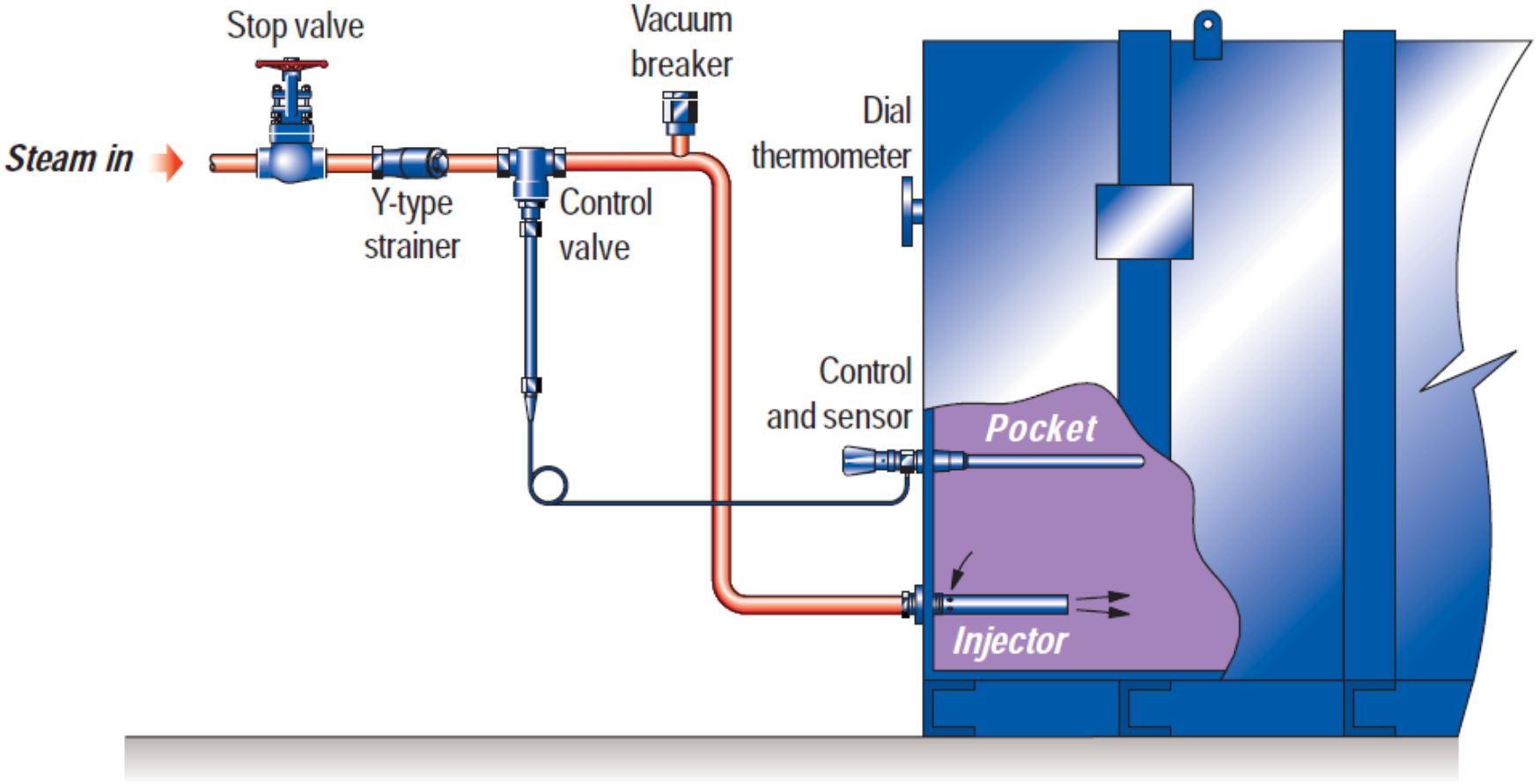
At 60°C Oxygen content = 4.8 ppm
At 85°C Oxygen content = 2.2 ppm

=> Approx saving in Sodium Sulphite = 50%*

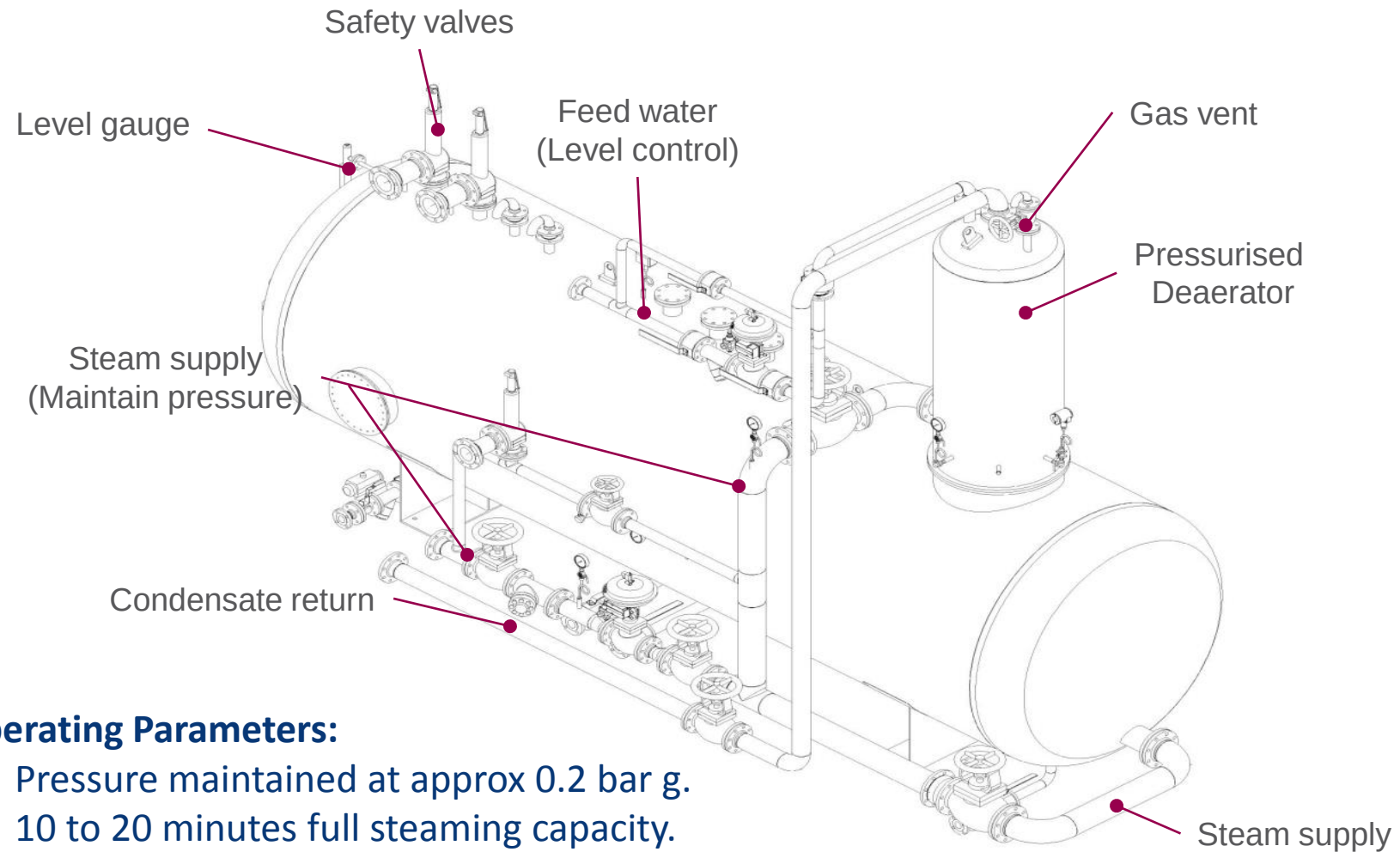
Flash Condensing Deaerator Head



Steam Injection system



Pressurised Deaerators

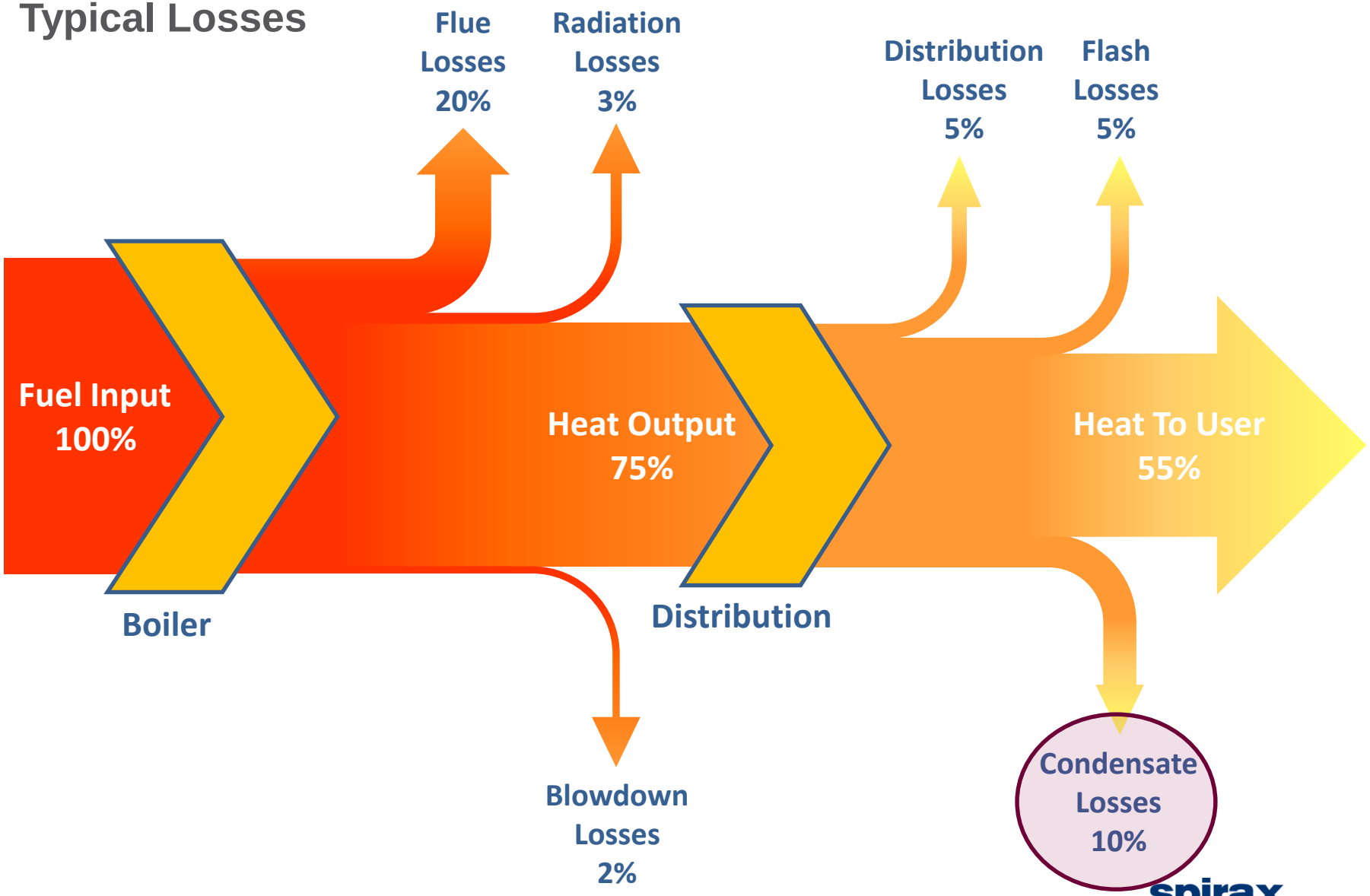


Operating Parameters:

- Pressure maintained at approx 0.2 bar g.
- 10 to 20 minutes full steaming capacity.
- Feedwater pressure greater the 2 bar g to give good distribution from nozzle.

THE STEAM SYSTEM LOSSES

Typical Losses



spirax sarco

Why return condensate?

Condensate is an extremely valuable resource. The high heat content justifies returning it to the feedwater system.

Condensate has already been treated and thus water treatment costs are lowered.

The high cost of condensate disposal is avoided.

Water charges are lowered because fresh water is not continually being added to the boiler.

Result: up to 20% fuel savings.

Calculating % Condensate Return:

By measuring the TDS of:

- Make up water (M)
- Boiler feed water (F)
- Condensate return (C)

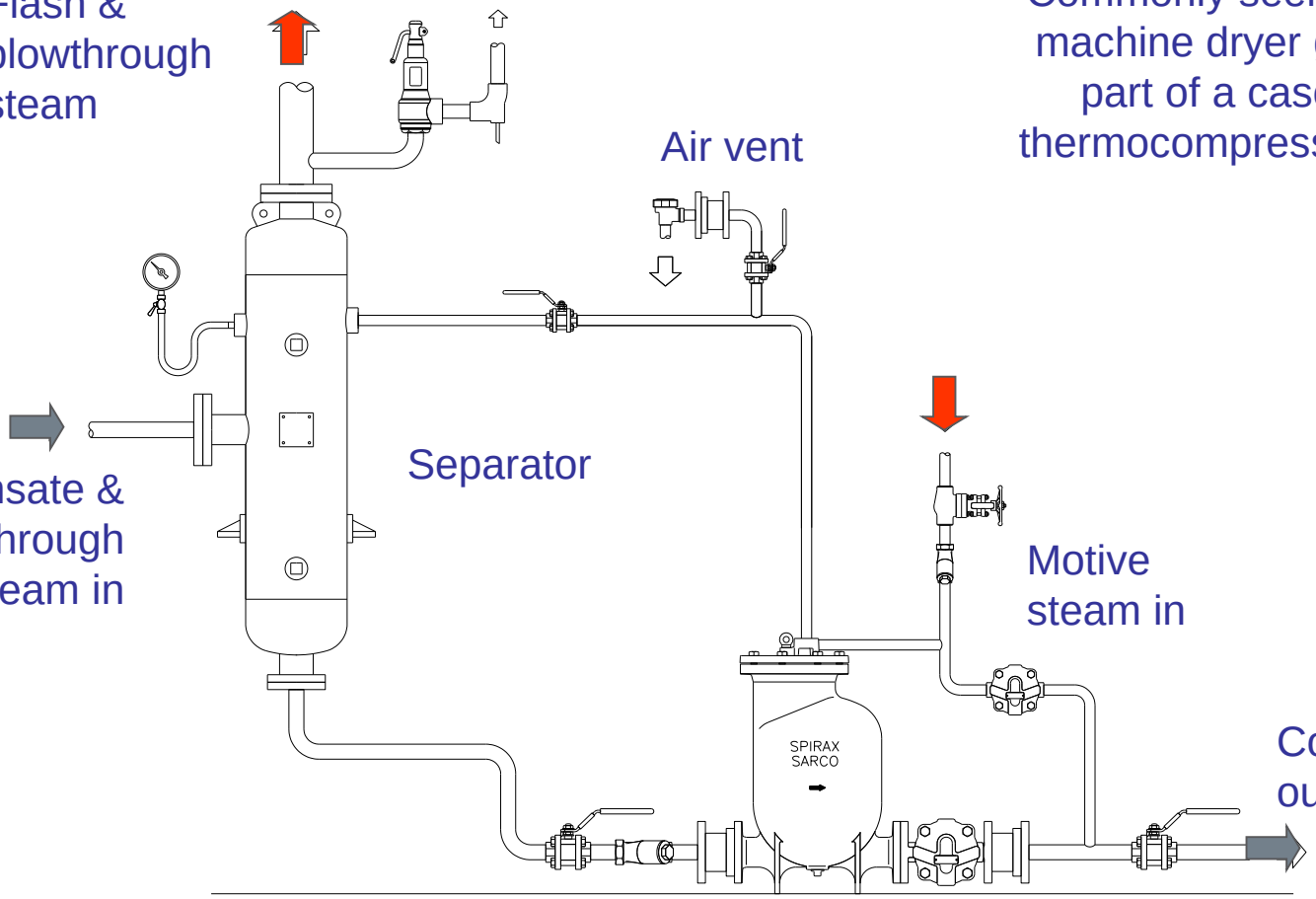
$$\% \text{ Condensate return: } = \frac{M - F}{M - C} \times 100\%$$

Flash separator using mechanical pump / steam trap combination

Flash & blowthrough steam

Air vent

Commonly seen on paper machine dryer groups as part of a cascade or thermocompressor system



Separator

Condensate & blowthrough steam in

Motive steam in

Condensate out

MFP / steam trap combination

Pump package

Simplex

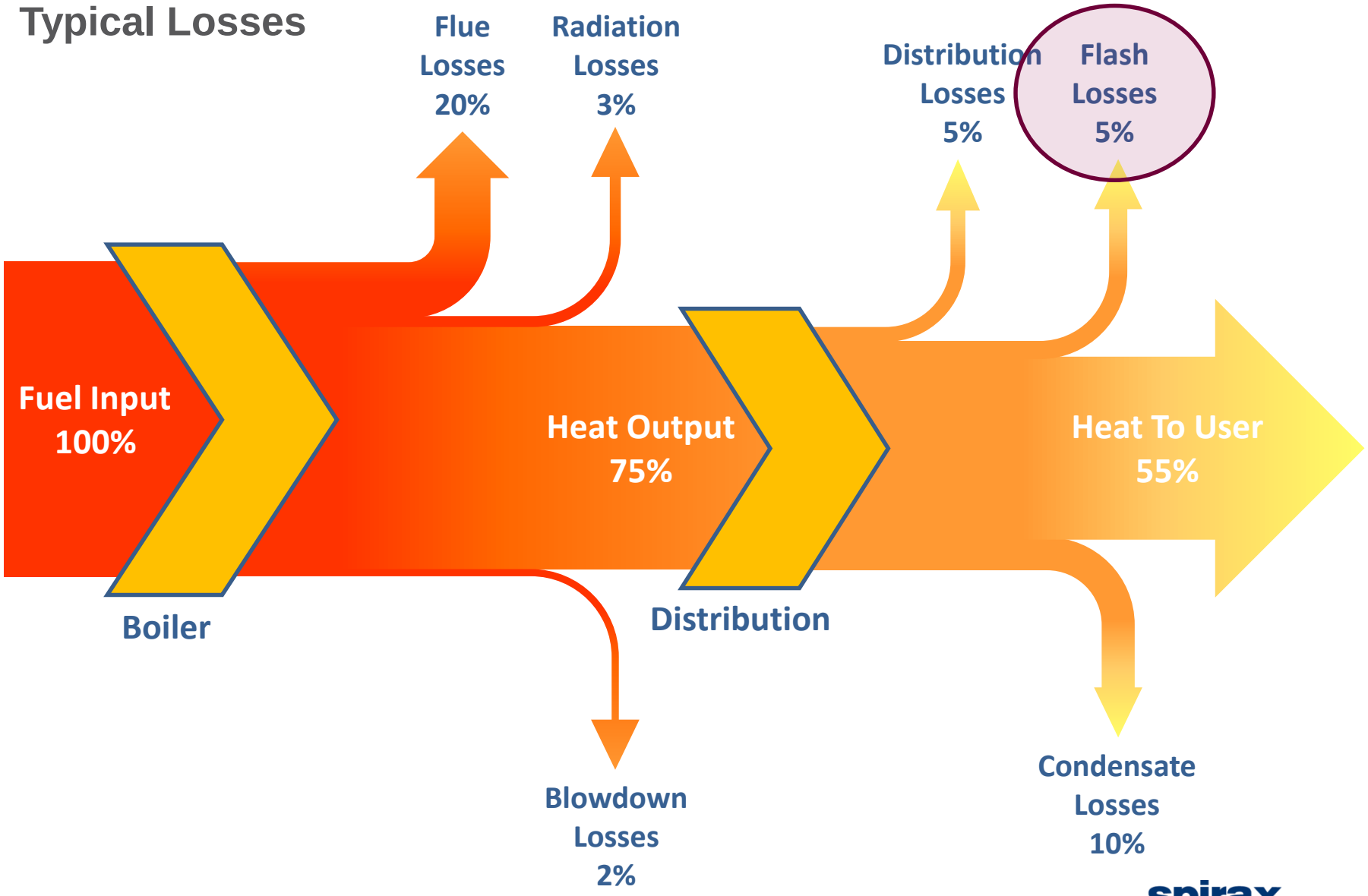
DN25,40,50,80

Duplex

DN80 x 50

THE STEAM SYSTEM LOSSES

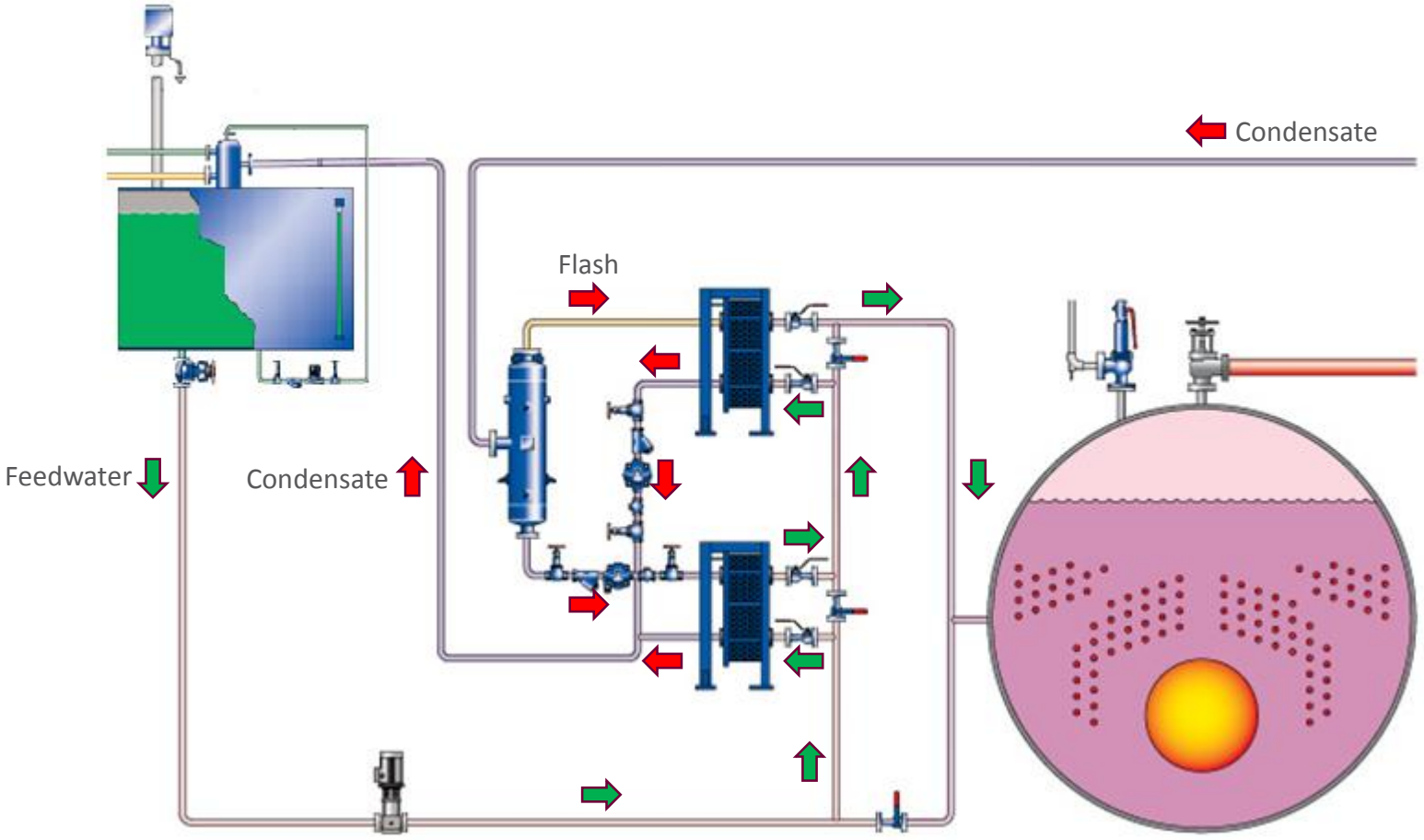
Typical Losses



spirax sarco

THE STEAM SYSTEM LOSSES

Flash Steam Recovery



Standard Package System

Award winning system

Awards for innovation and excellence 09 Winner

CARBON TRUST INNOVATION AWARDS 2009 FINALIST

First THE CIBSE LOW CARBON PERFORMANCE AWARDS 2010 olutions

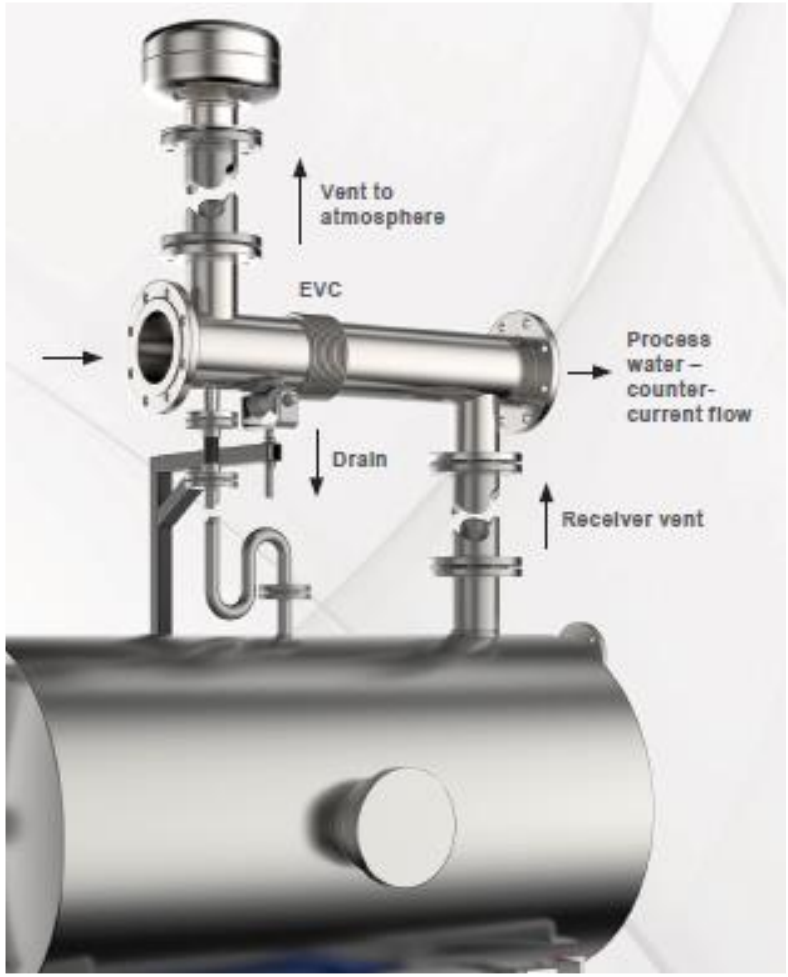
Exhaust Vapour Condensers (EVCs)

EVCs are used to:

- Condense flash steam being vented to atmosphere
- Utilise low pressure steam to preheat water or process fluids

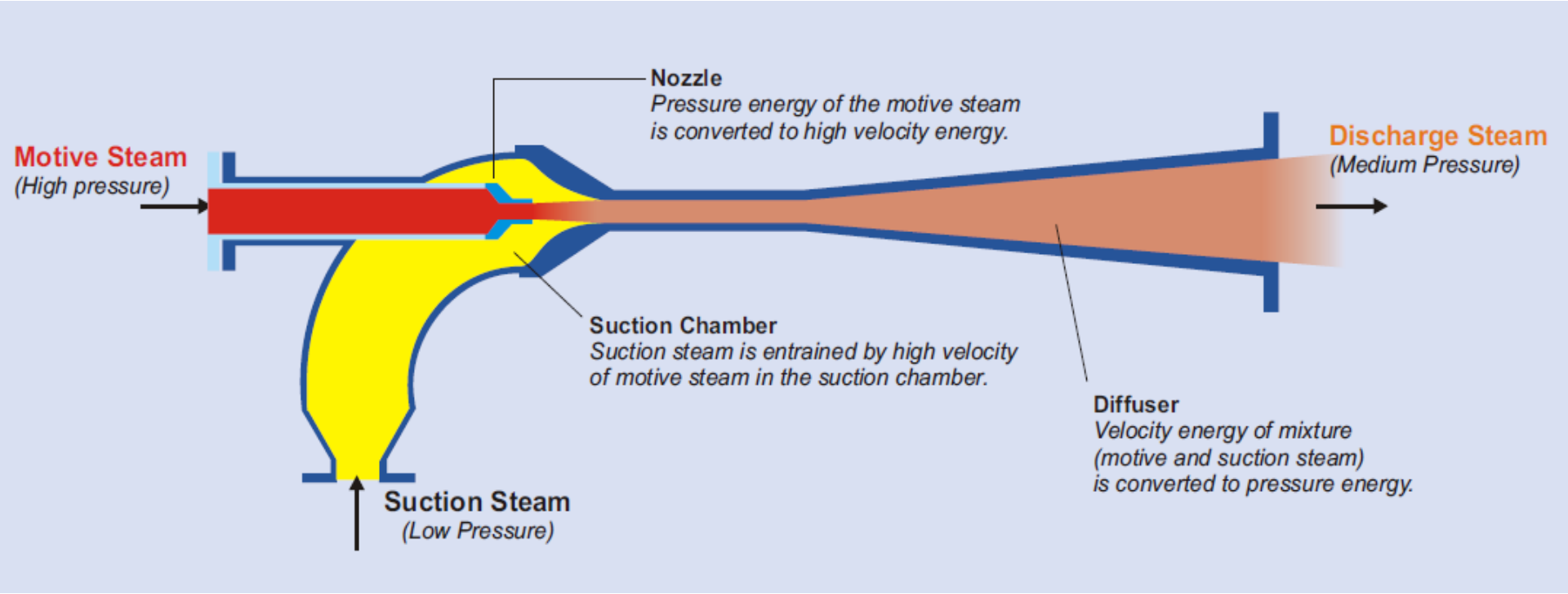
Benefits:

- Remove unsightly plumes of flash steam
- Reduce energy and emissions (where energy can be utilised)
- Saves water
- Reduces water treatment costs

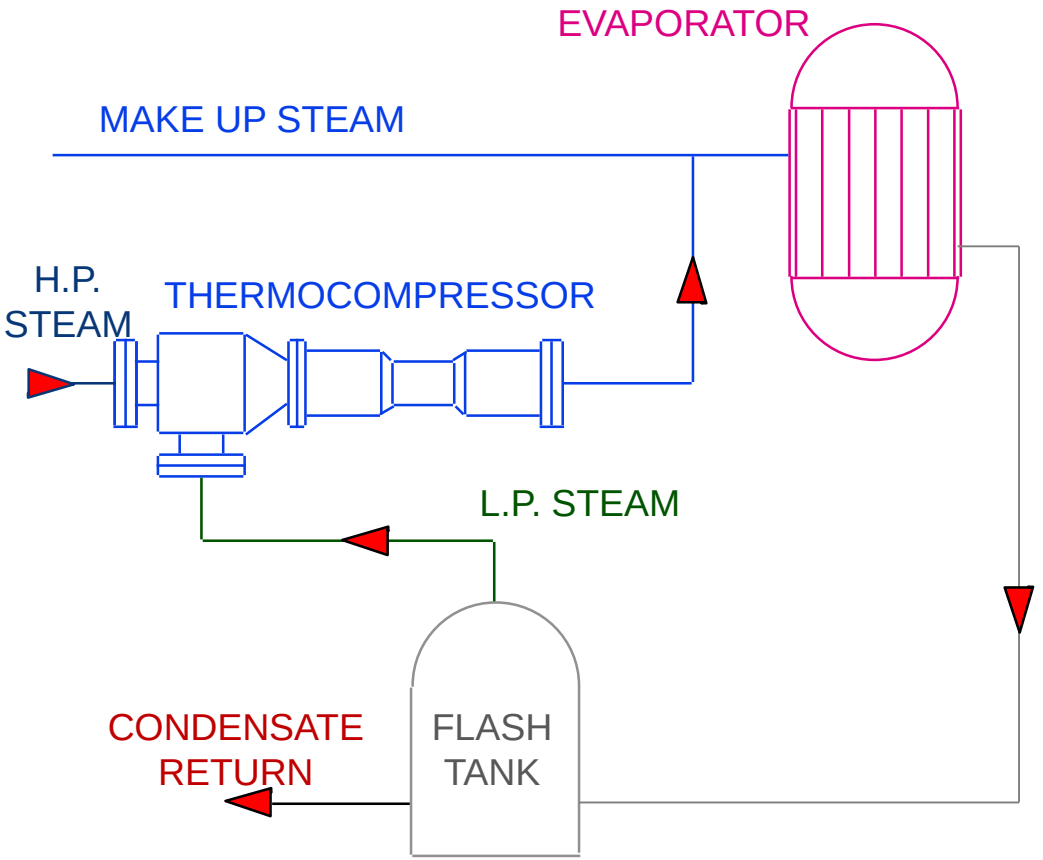


Thermocompressors

A thermocompressor utilises high pressure steam (*motive steam*) to re-energise low pressure steam (*suction steam*) to produce medium pressure steam (*discharge steam*).



Typical Applications - Evaporators



Evaporator

Desolventiser Toaster

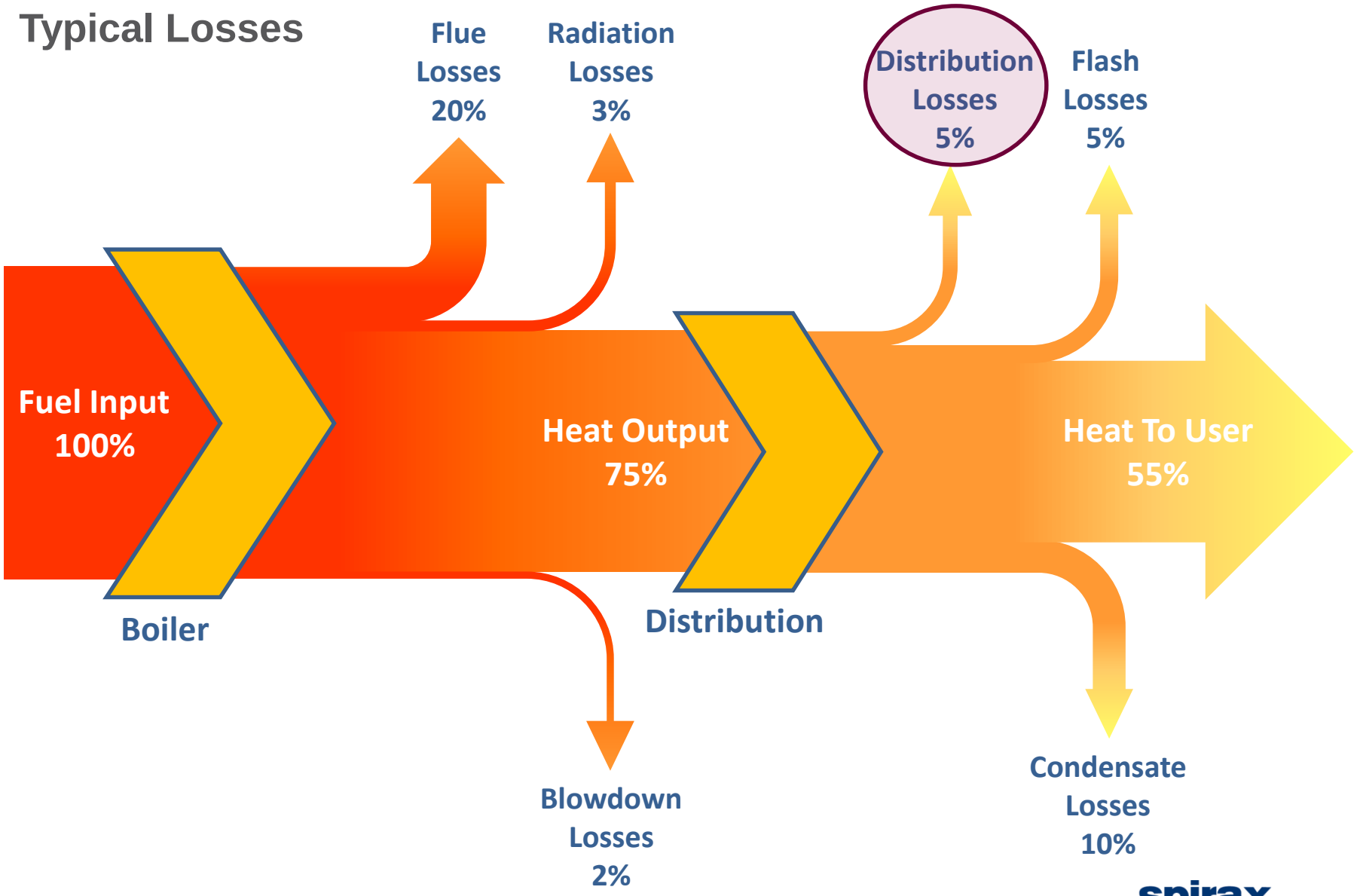
Deodorisers

Evaporator pressure: 4 bar g

Flash steam : 0.5 bar g

THE STEAM SYSTEM LOSSES

Typical Losses



spirax sarco

Distribute at High Pressure

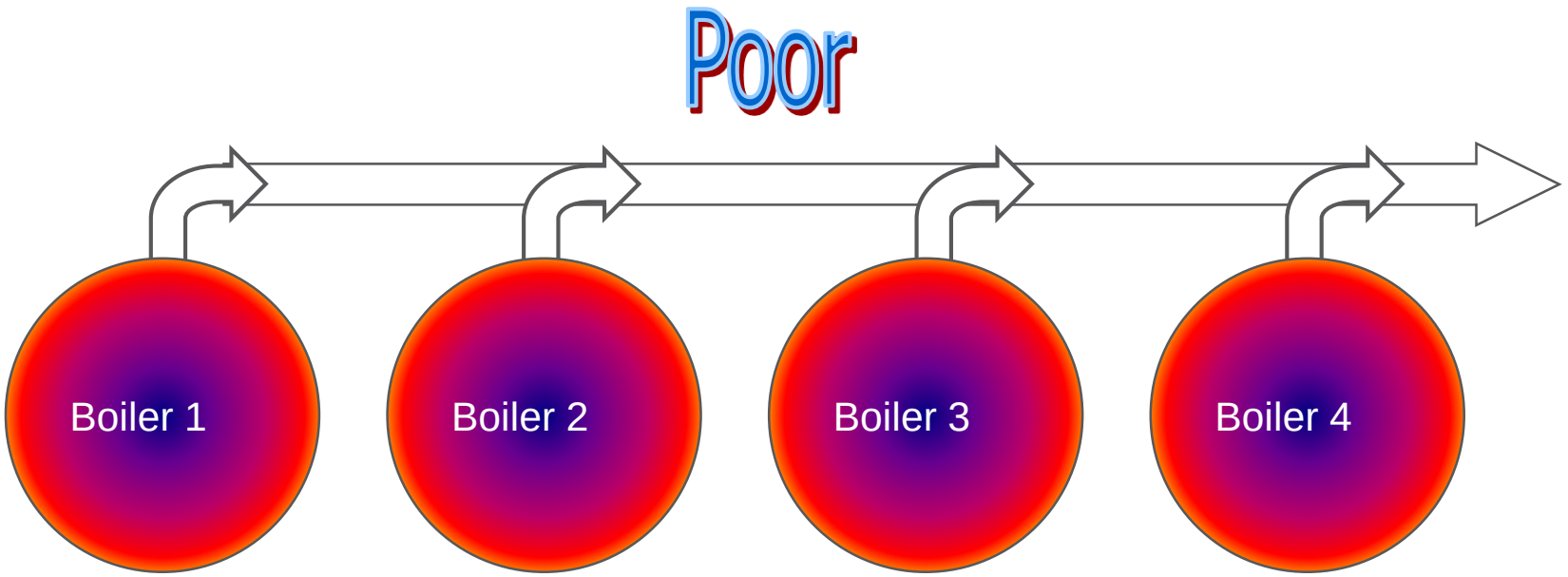
This will have the following advantages:

- Smaller bore steam mains needed and therefore less heat (energy) loss due to the smaller surface area.
- Lower capital cost of steam mains, both materials such as pipes, flanges and support work and labour.
- Lower capital cost of insulation (lagging).
- Dryer steam at the point of usage because of the drying effect of pressure reduction taking place.
- The boiler can be operated at the higher pressure corresponding to its optimum operating condition, thereby operating more efficiently.
- The thermal storage capacity of the boiler is increased, helping it to cope more efficiently with fluctuating loads, and a reduced risk of priming and carryover

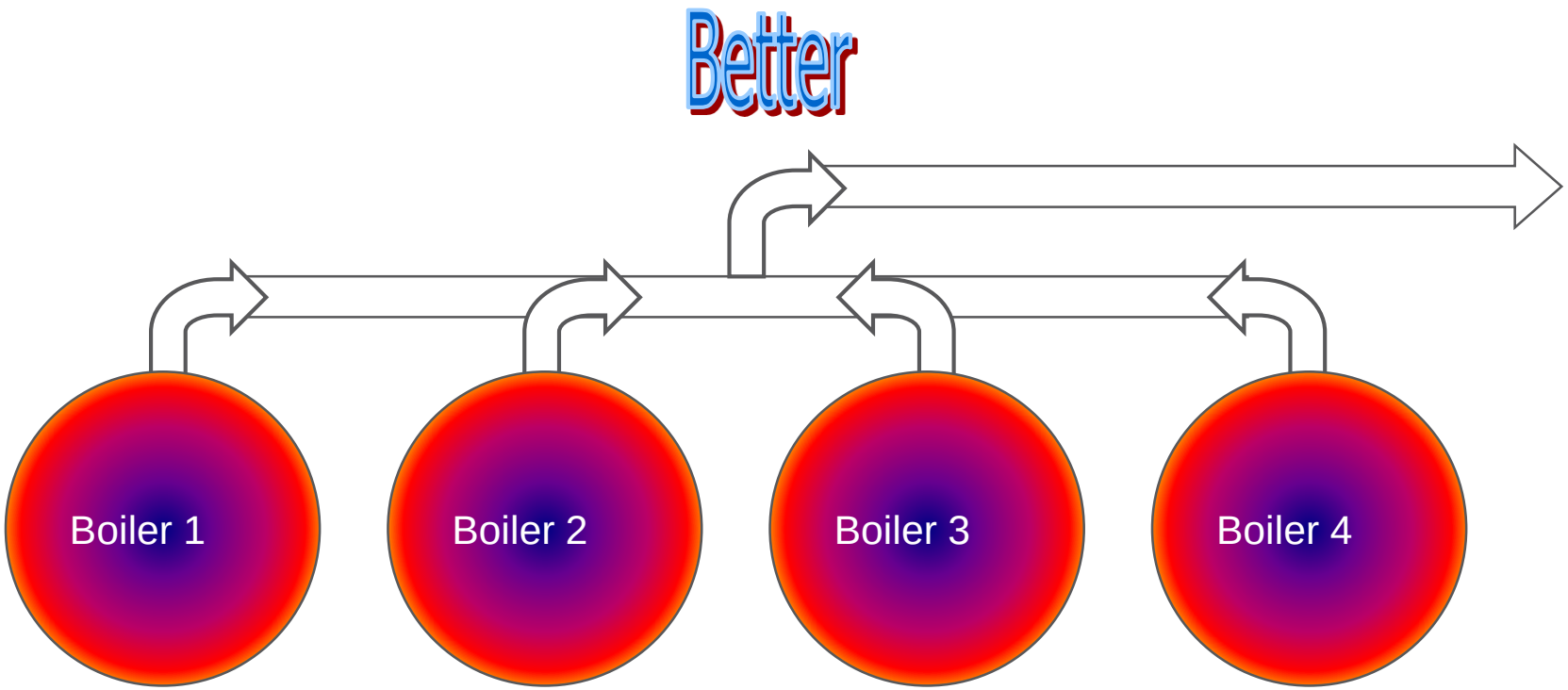
Use at low pressure

- Higher enthalpy of evaporation - slightly less mass flow rate
- Less heat remaining in condensate , therefore less flash steam formed
- More dryer steam will be available after PRV.

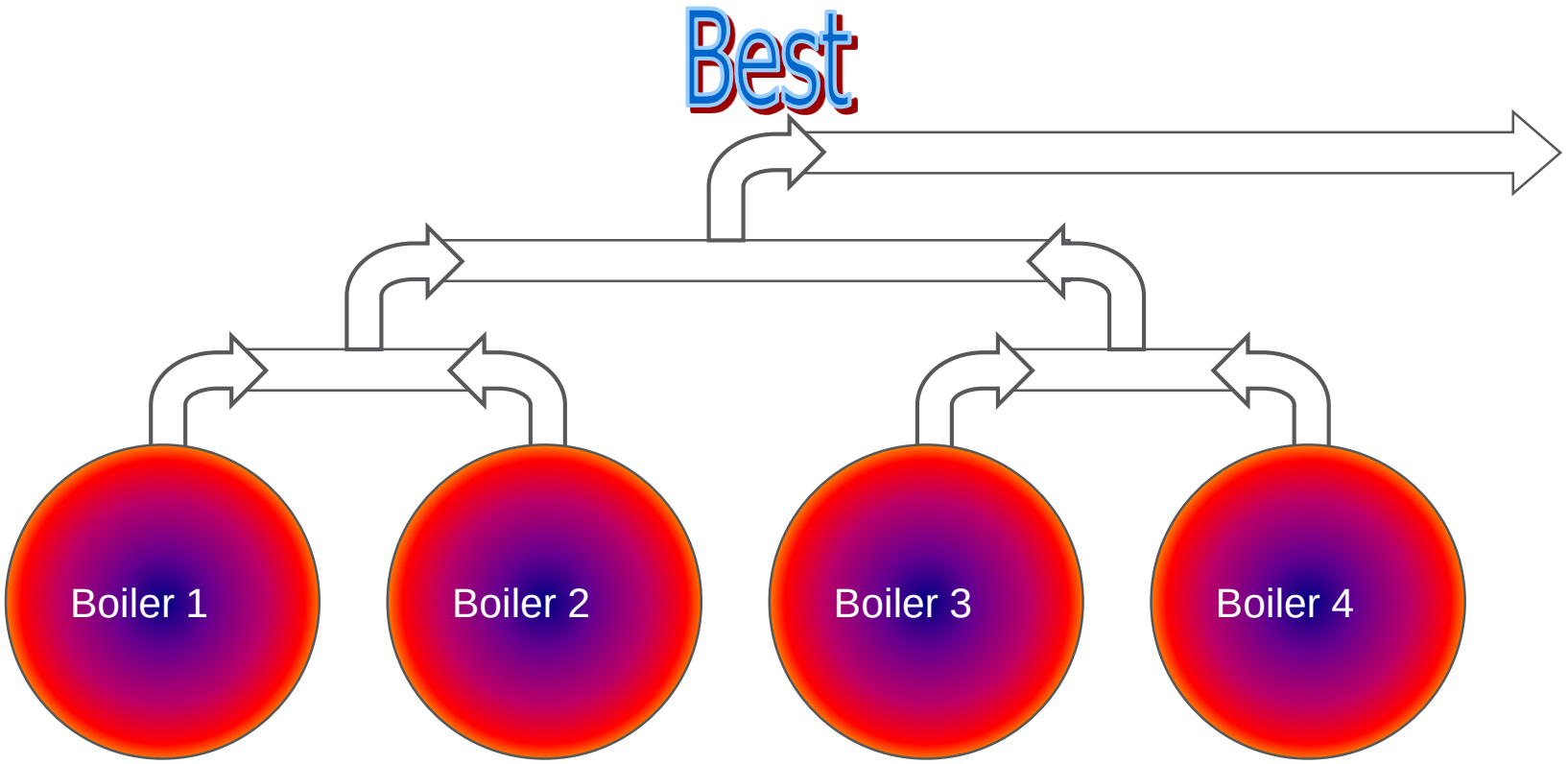
Steam Distribution Headers



Steam Distribution Headers



Steam Distribution Headers



Pipe Sizing

Oversizing

- Greater Cost
- Greater Heat Loss
- Greater Volume of Condensate Formed

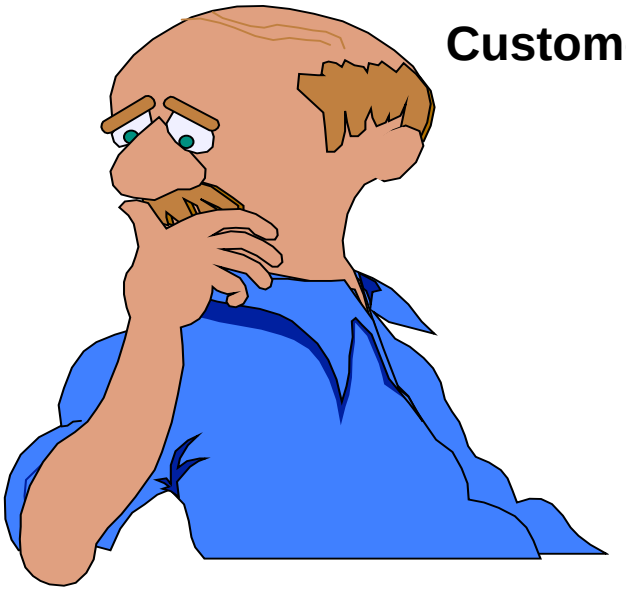
Undersizing

- Lower Pressure to Steam Users, or
- Not Enough Volume of Steam
- Water Hammer and Erosion

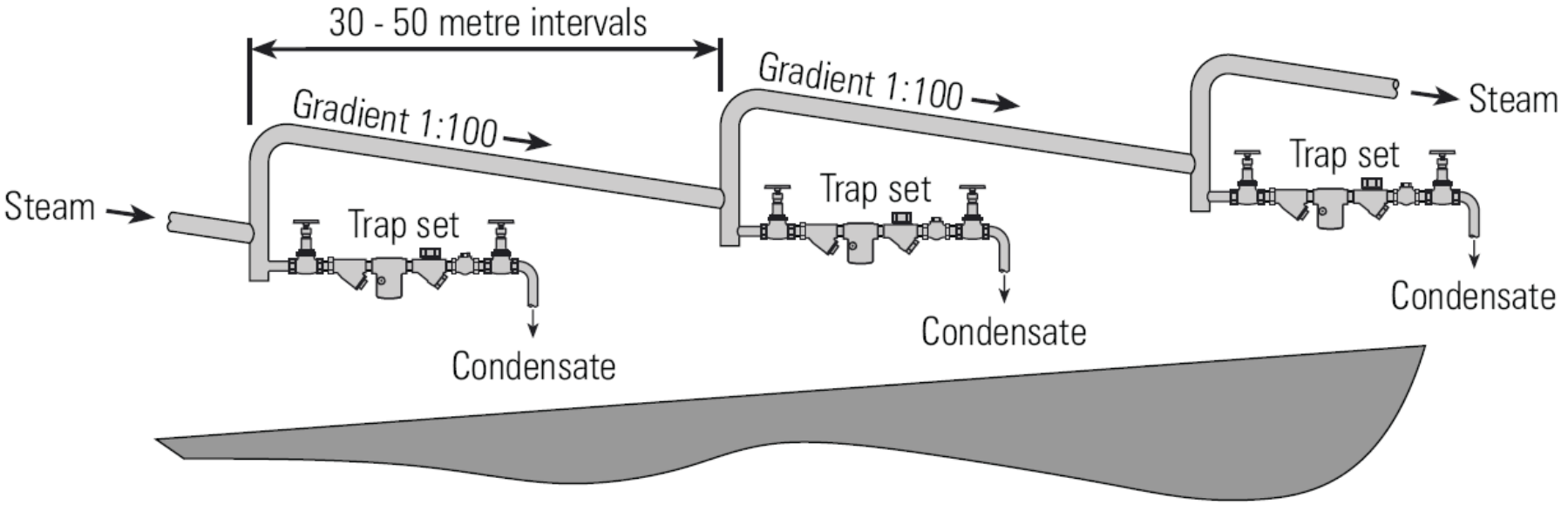
How do we size steam pipes?

On the basis of:

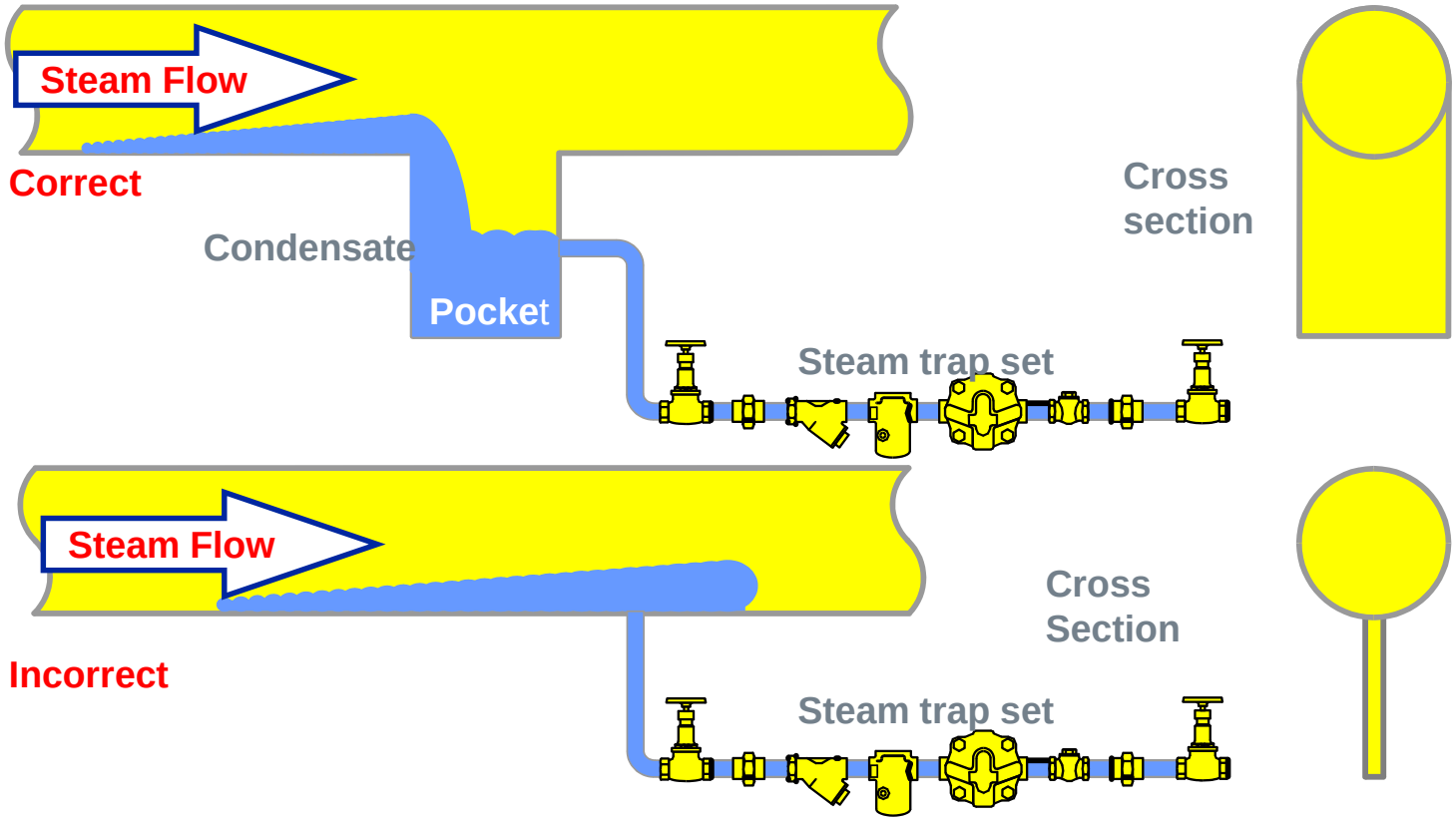
- Steam velocity
- Pressure drop



Typical steam main installation



Ineffective, and proper drain points



Recommended drain pocket dimensions

Mains diameter - D	Pocket diameter - d_1	Pocket depth - d_2
Up to 100 mm nb	$d_1 = D$	Minimum $d_2 = 100$ mm
125 - 200 mm nb	$d_1 = 100$ mm	Minimum $d_2 = 150$ mm
250 mm and above	$d_1 \geq D/2$	Minimum $d_2 = D$

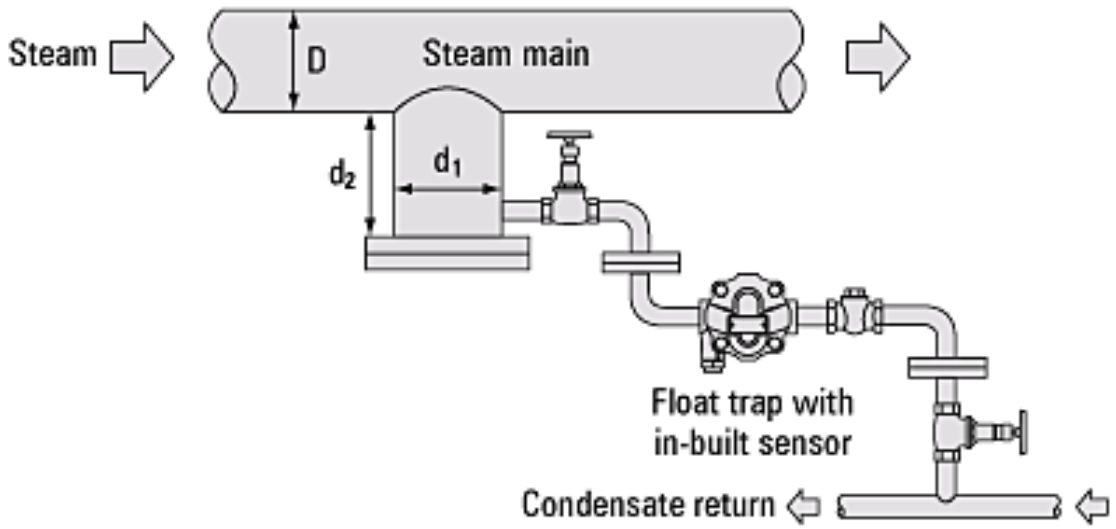
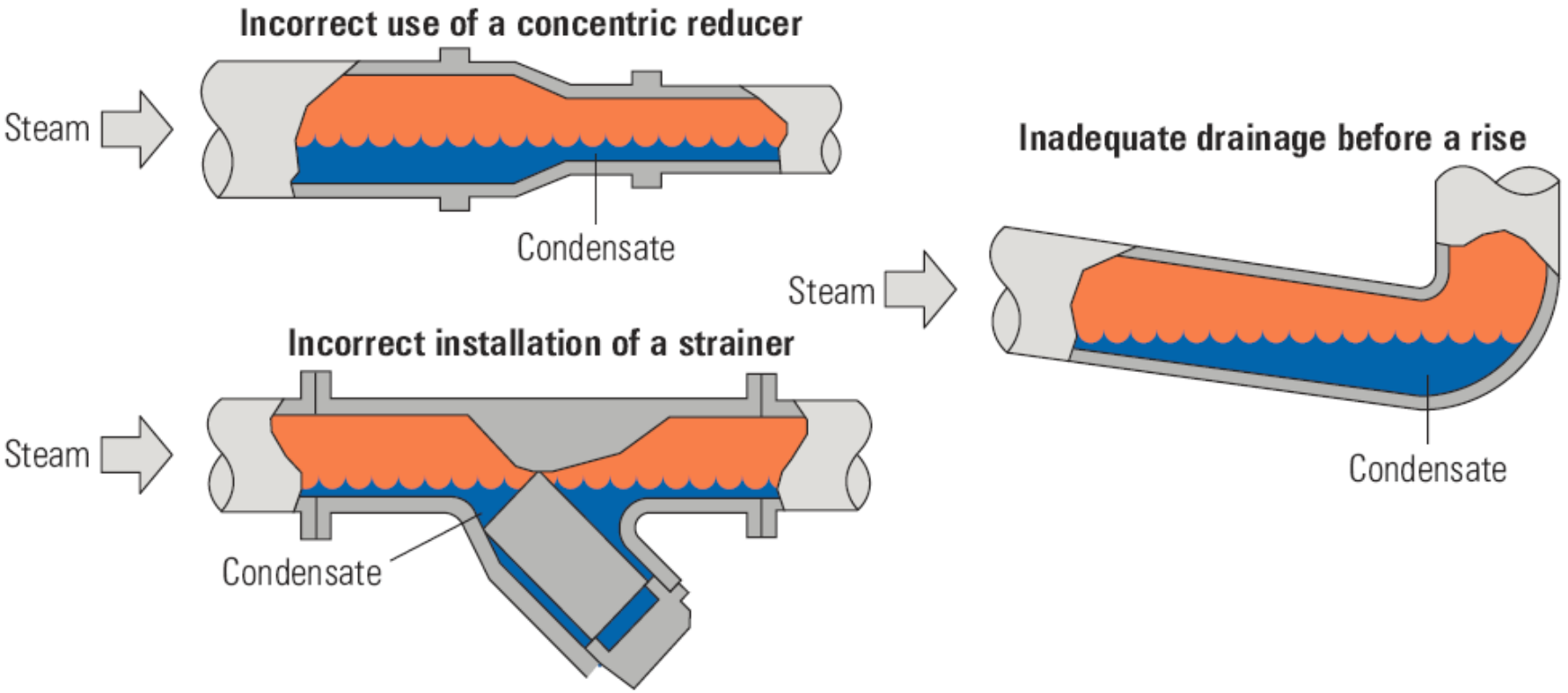
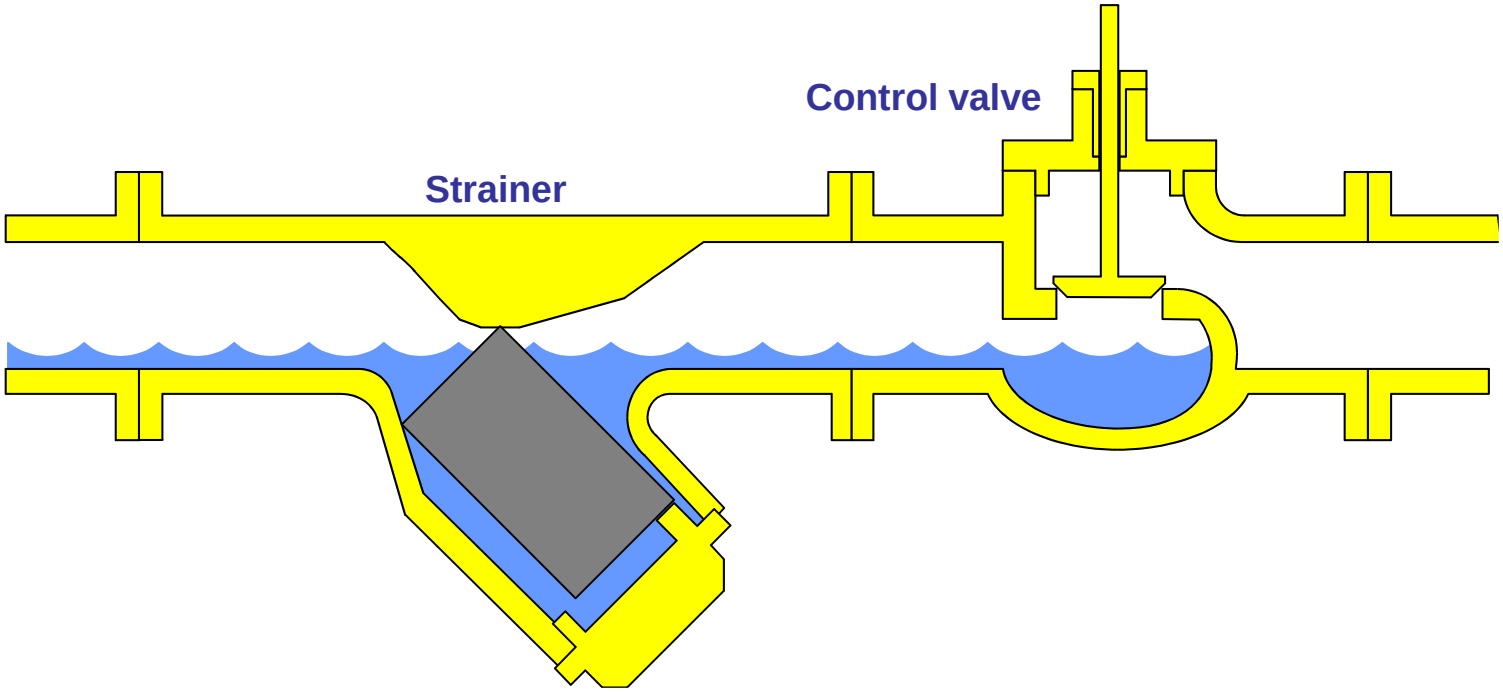


Fig. 10.3.4

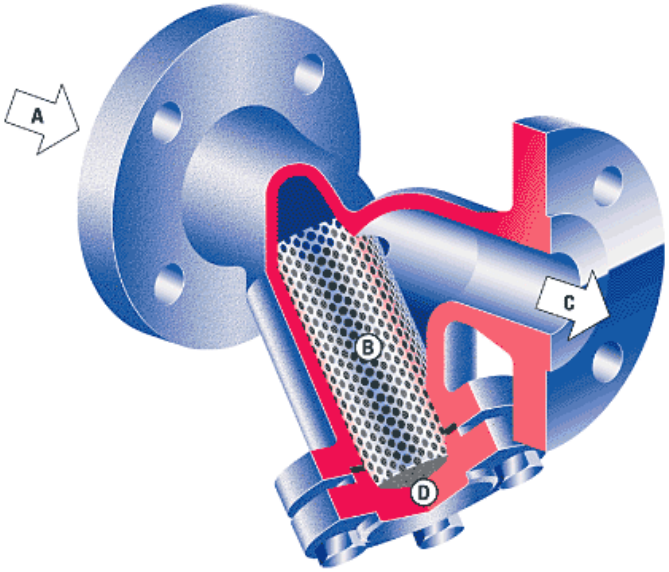
Potential sources of waterhammer

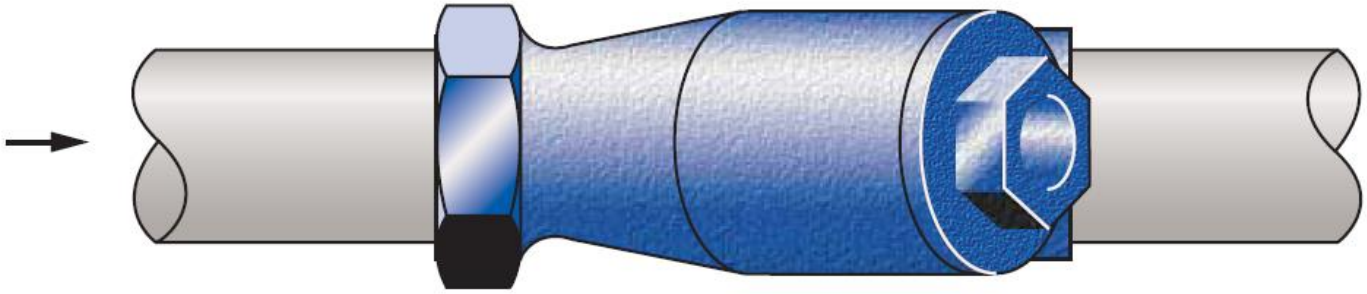


Strainers



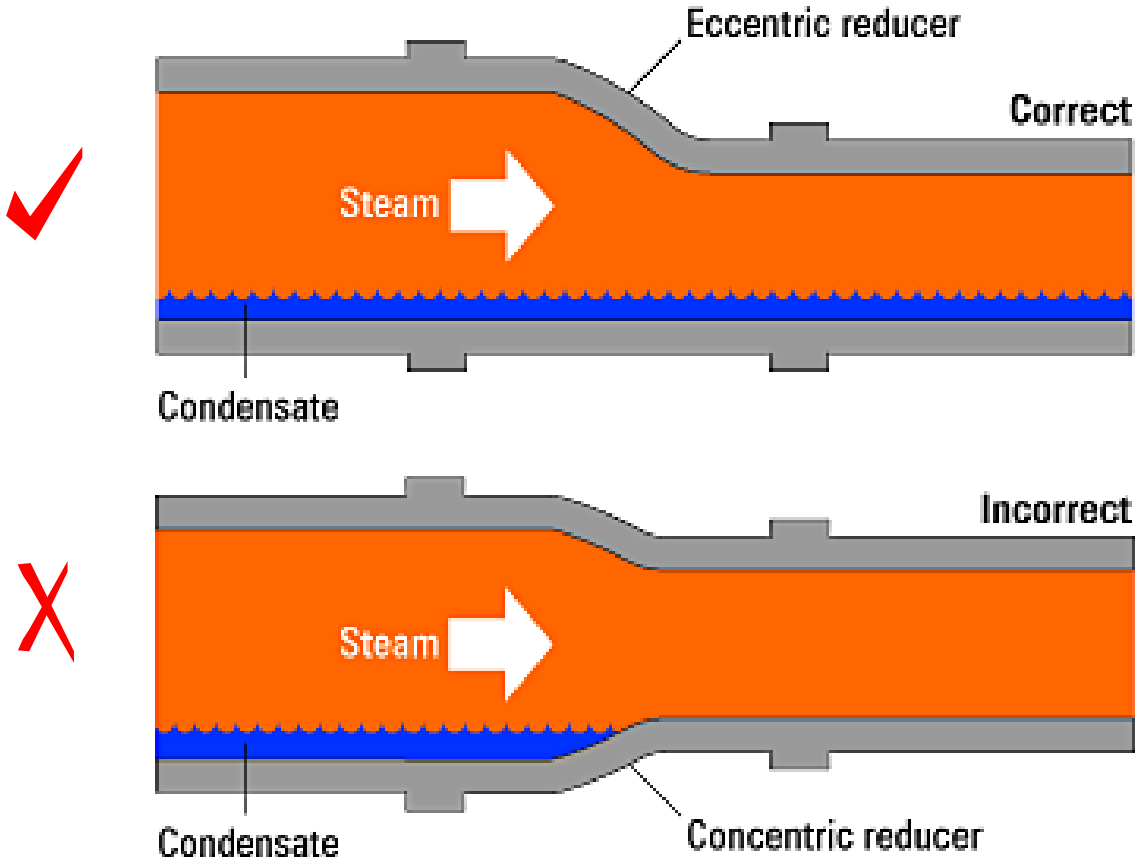
Strainer





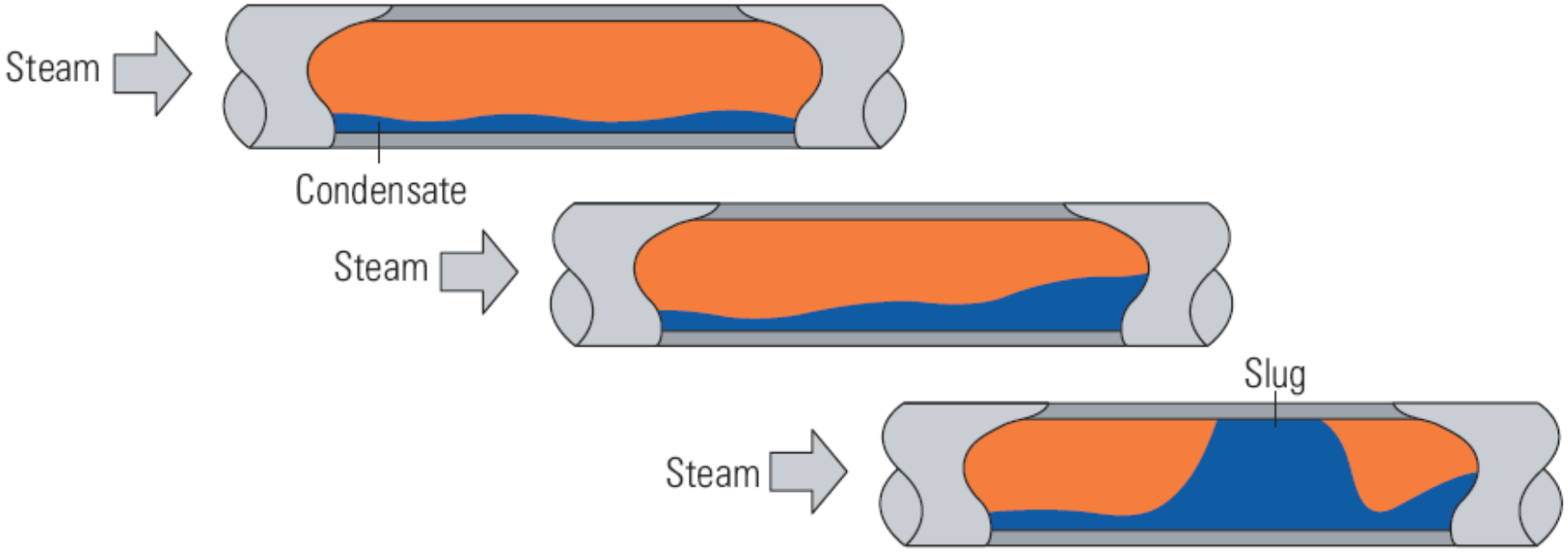
First f

Steam line reducers

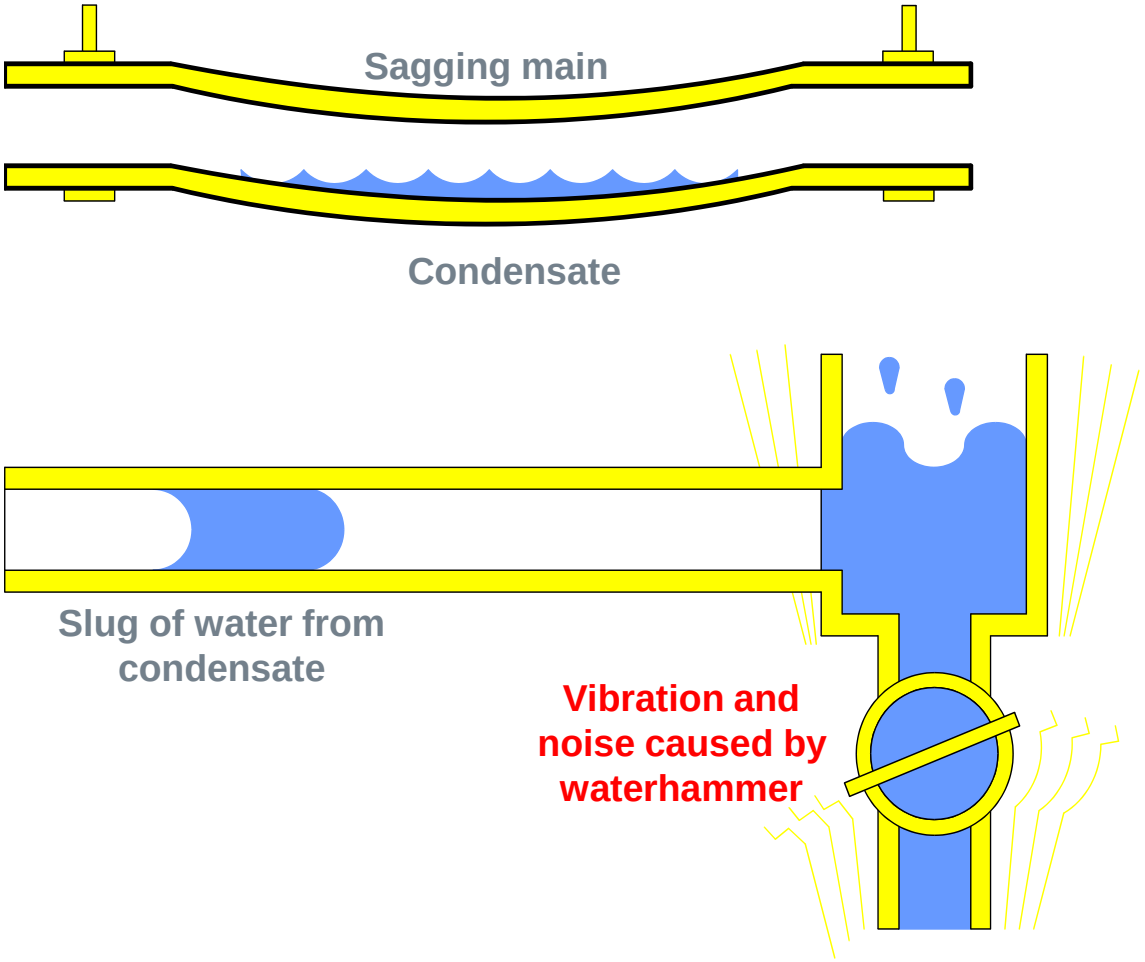


Formation of a ‘solid’ slug of water

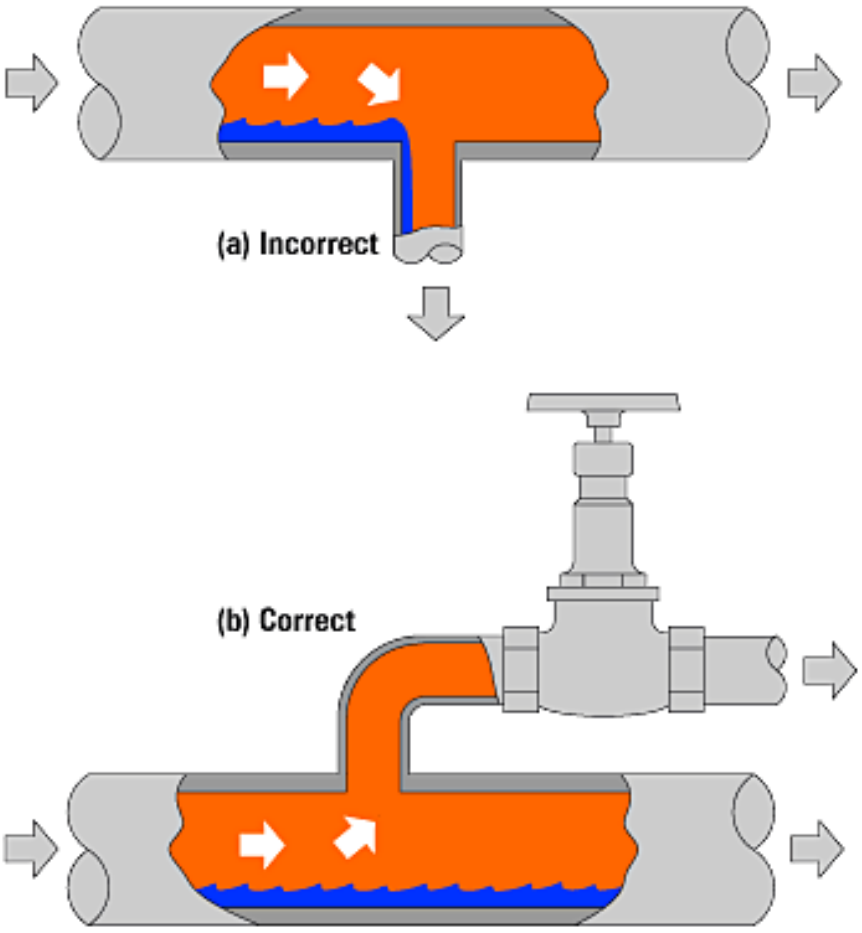
‘solid’ slug of water will produce waterhammer



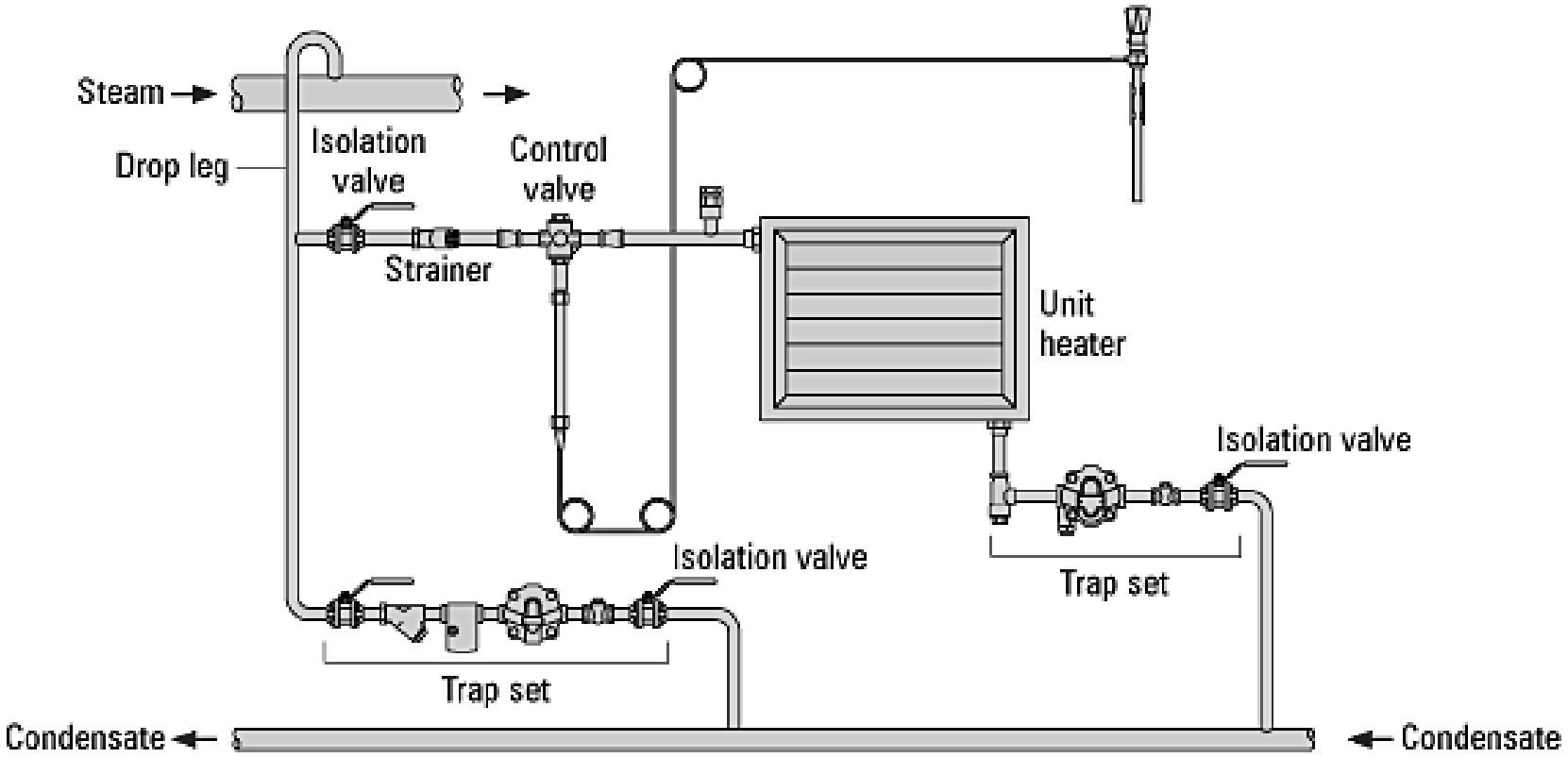
Waterhammer



Branch connections



Drain at low point



THE STEAM SYSTEM LOSSES

Distribution Losses

Ambient Temperature 21 °C

ΔT =~150°C

Temperature difference steam to air °C	Pipe size (DN)									
	15	20	25	32	40	50	65	80	100	150
	W/m									
60	60	72	88	111	125	145	172	210	250	351
70	72	87	106	132	147	177	209	253	311	432
80	86	104	125	155	174	212	248	298	376	519
90	100	121	146	180	203	248	291	347	443	610
100	116	140	169	207	233	287	336	400	514	706
110	132	160	193	237	267	328	385	457	587	807
120	149	181	219	268	302	371	436	517	664	914
130	168	203	247	301	342	417	490	581	743	1025
140	187	226	276	337	382	464	547	649	825	1142
150	208	250	306	374	424	514	607	720	911	1263
160	229	276	338	413	469	566	670	794	999	1390
170	251	302	372	455	515	620	736	873	1090	1521
180	275	330	407	499	566	676	805	955	1184	1658
190	299	359	444	544	615	735	877	1041	1281	1800
200	325	389	483	592	681	795	951	1130	1381	1947

Heat emission from bare pipes

Heat Loss = 514 W/m
For 100m = 51.4 kW
Condensing Rate = 90 kg/h

Insulation can reduce losses to 1/10th

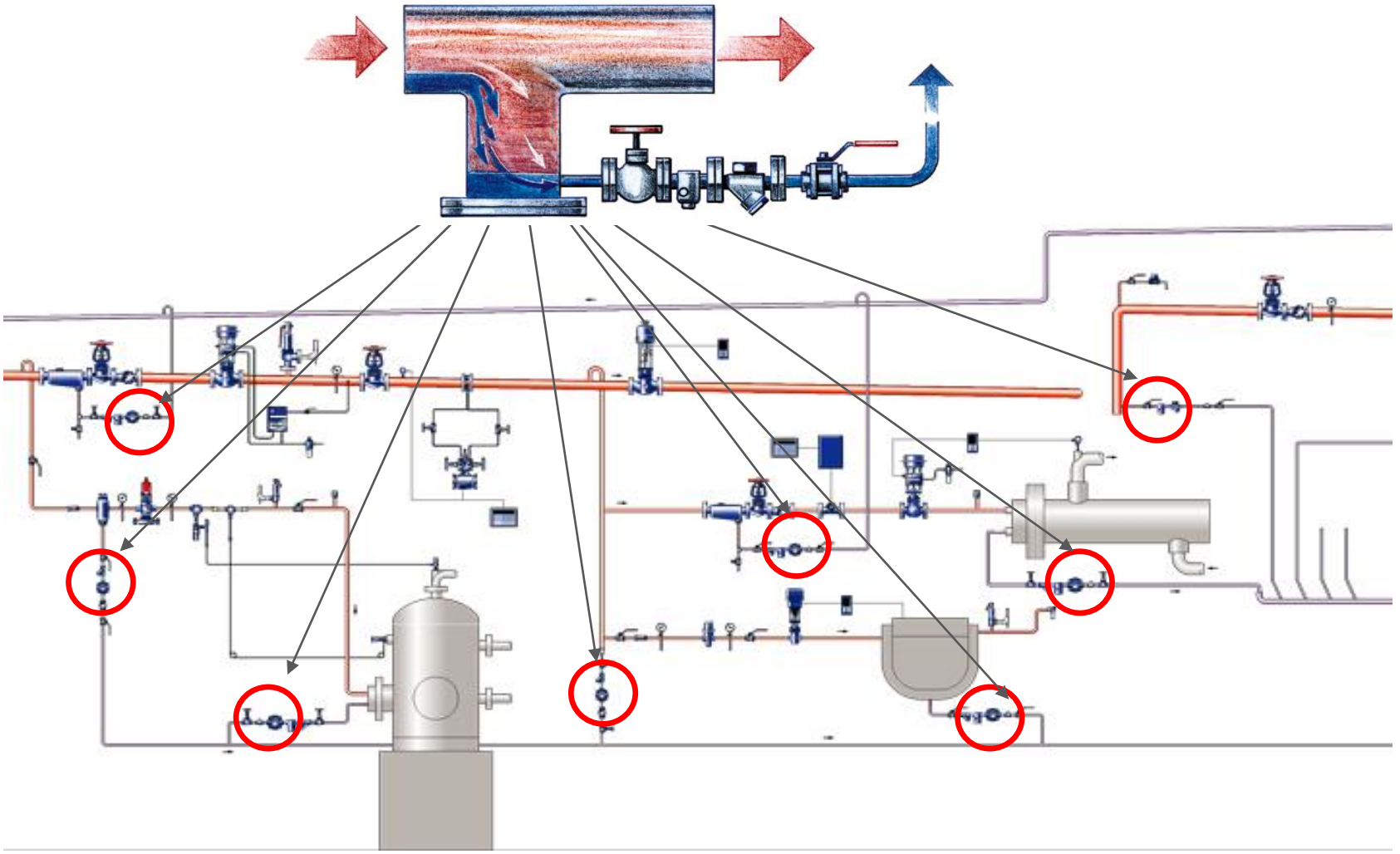
THE STEAM SYSTEM LOSSES

Distribution Losses

- Steam leaks
  How much are they costing you?
- 25 mm valve stem 8 barg
  3.5 kg/h ~0.62 lacs per annum
- 2 mm hole, steam at 7 barg
  9 kg/h ~Rs 1.58 lacs per annum
- 5 m of 50 mm pipe Rs 6,49,600 per annum (insulate reduce to 1/10th)
- Incorrect installed drainage points
- Correct pipe sizing
- Condition of steam
  (e.g. dryness fraction)

THE STEAM SYSTEM LOSSES

Distribution Losses: Steam Traps



71

THE STEAM SYSTEM LOSSES

Distribution Losses: Steam Traps

Failed Open Steam Trap	Failed Closed (Cold) Steam Trap
Waste of energy/money Increases production costs Plumes of steam visible form vents Can cause problems in pipes Plant will still operate	Plant will waterlog Reduced plant output Spoilt product Under heating Safety hazard – waterhammer Freezing

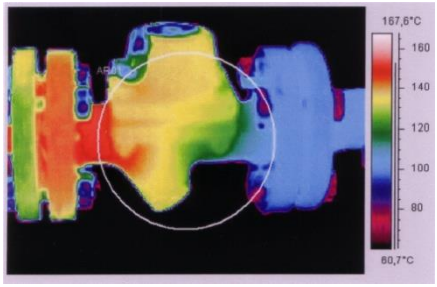
Failed open steam trap with a 5 mm orifice, operating at 7 barg will lose approximately 30 kg/h. Over 260 t per annum

THE STEAM SYSTEM LOSSES

Trap Monitoring

Open Discharge

Sound /
Ultrasonic



Temperature

Trap Monitoring

Sight Glass

Conductivity

Combined Conductivity
& Temperature

STAPS Wireless Steam Trap Monitoring

HEAD ASSEMBLY

- Including computer, 2.4 GHz wireless transmitter/receiver, battery, LED indicator and mounting bracket

SENSOR ASSEMBLY

- Including vibro-acoustic sensor, temperature sensor and heat sink

CLAMP ASSEMBLY

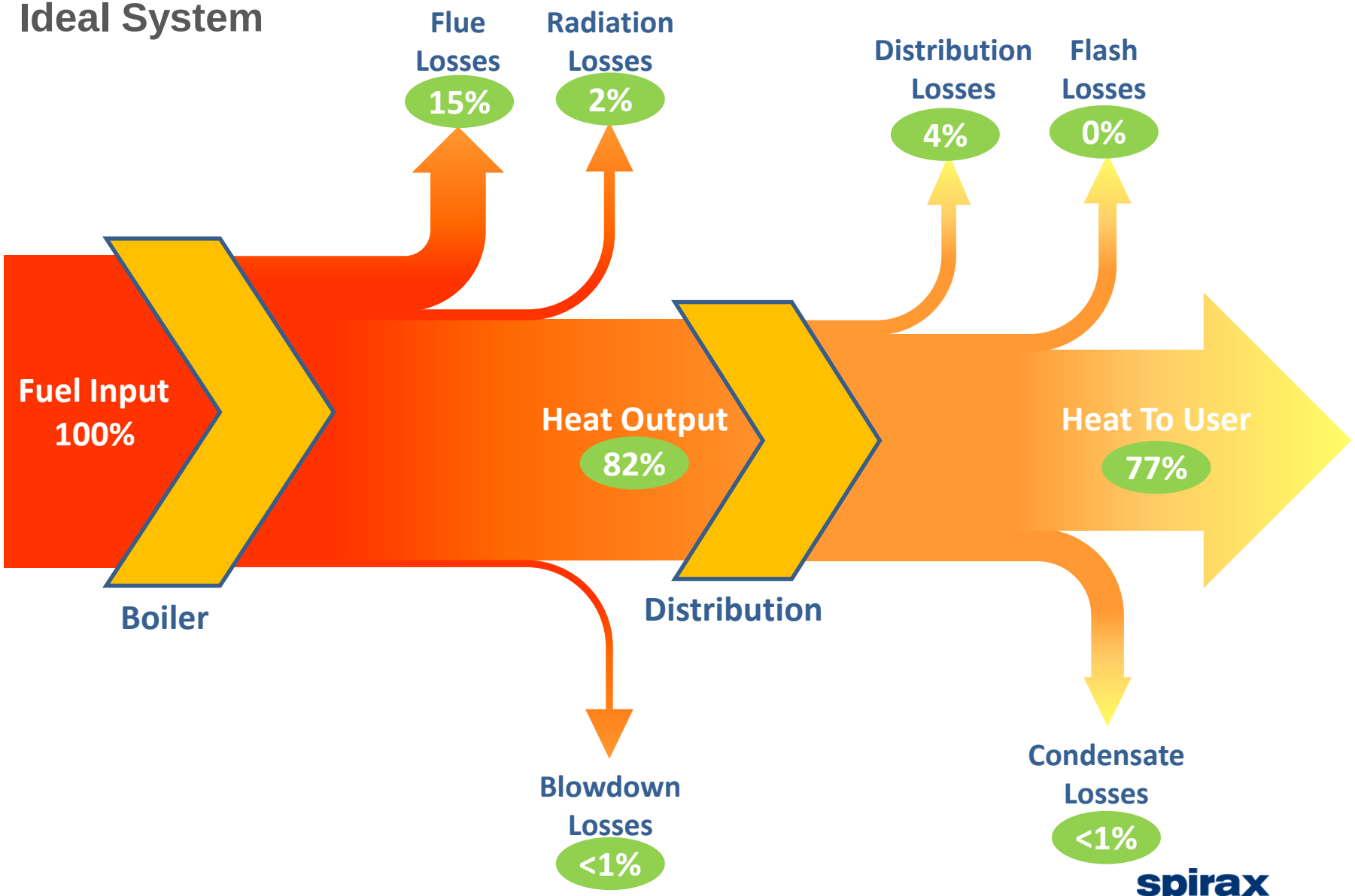
- For mounting to condensate lines up to 4”

First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

THE STEAM SYSTEM LOSSES

Ideal System



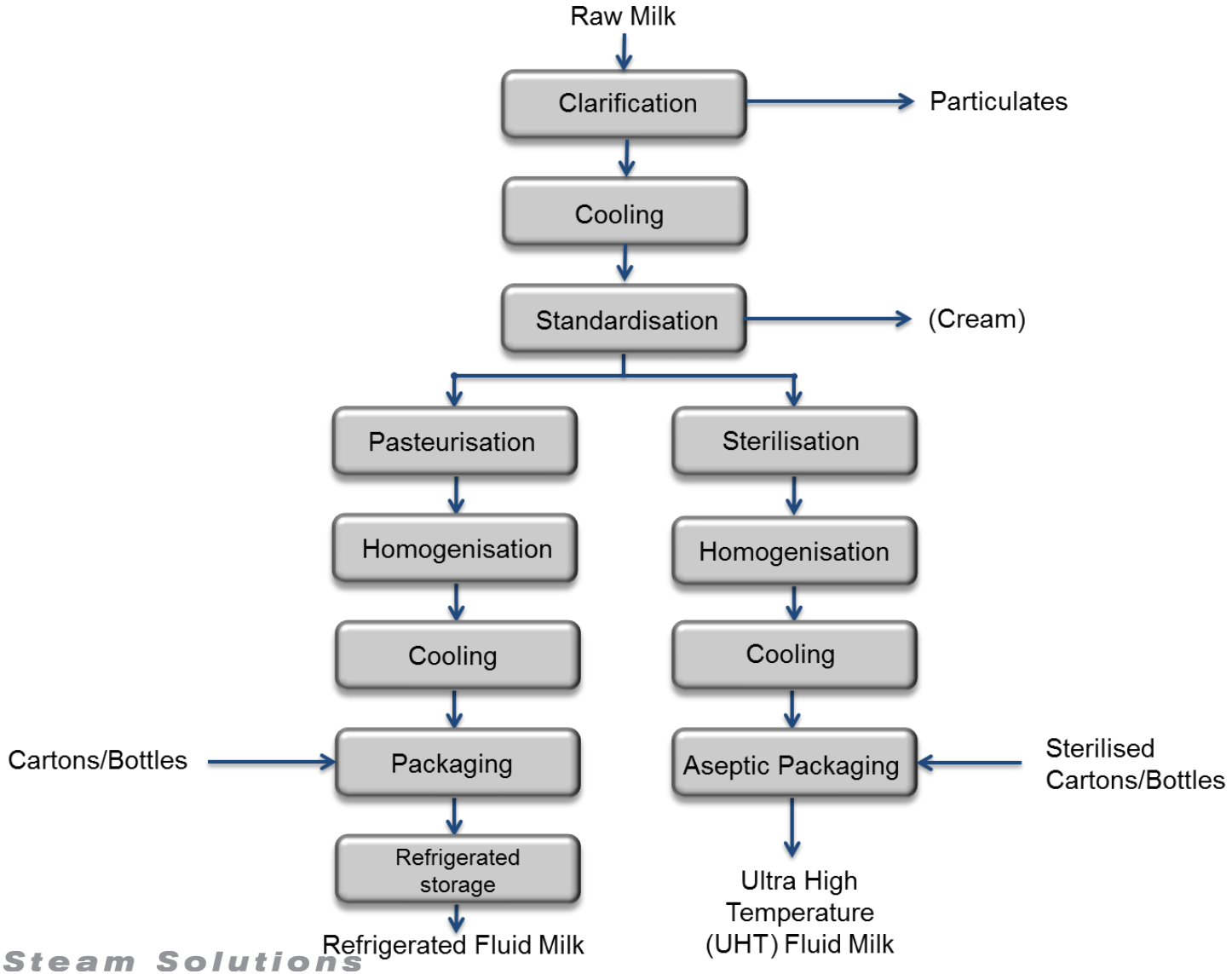
spirax sarco

Pasteurised Milk Opportunities

First for Steam Solutions

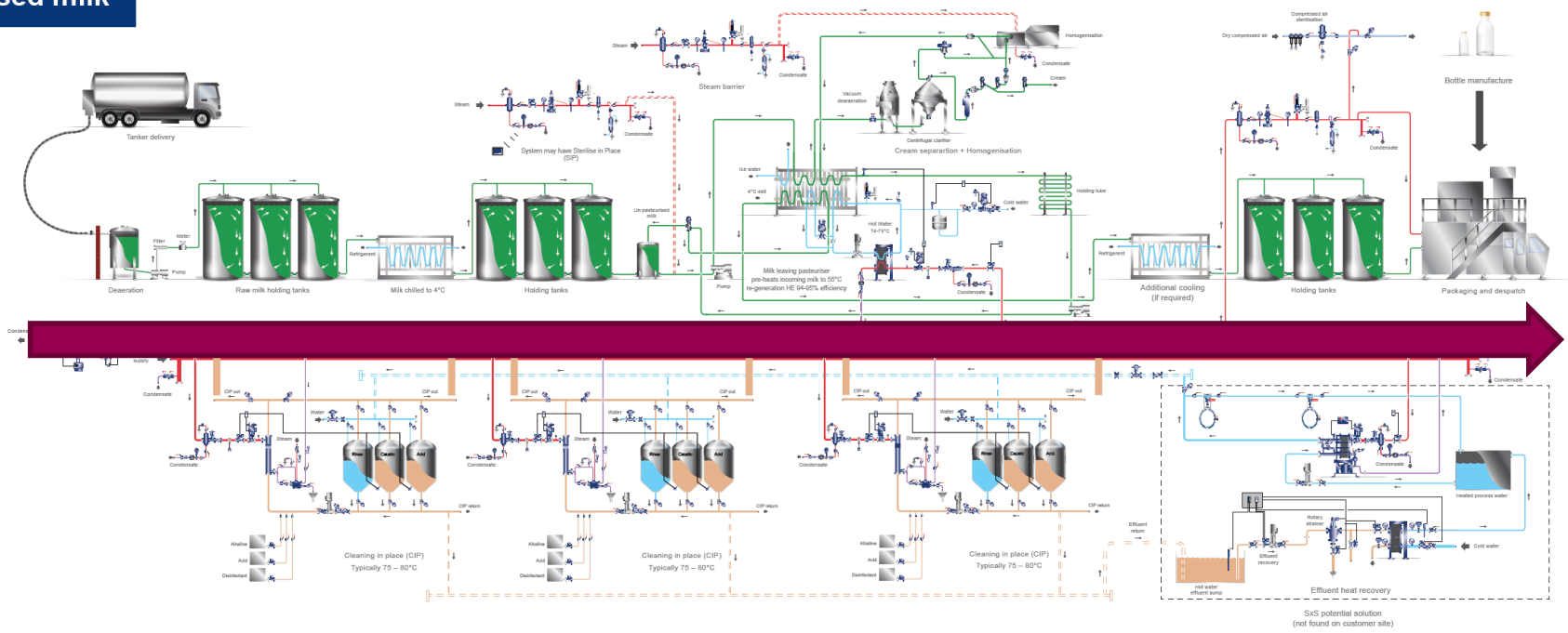
EXPERTISE | SOLUTIONS | SUSTAINABILITY

Pasteurised Milk Process Diagram

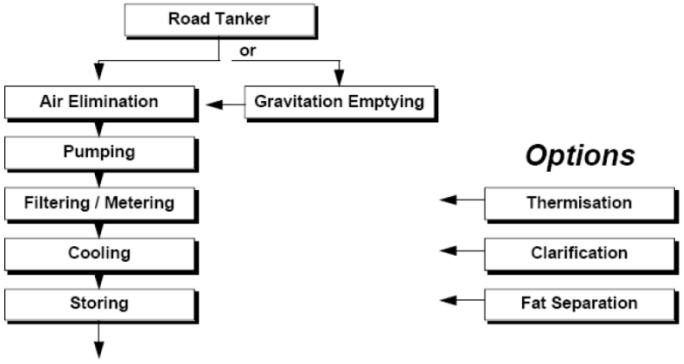


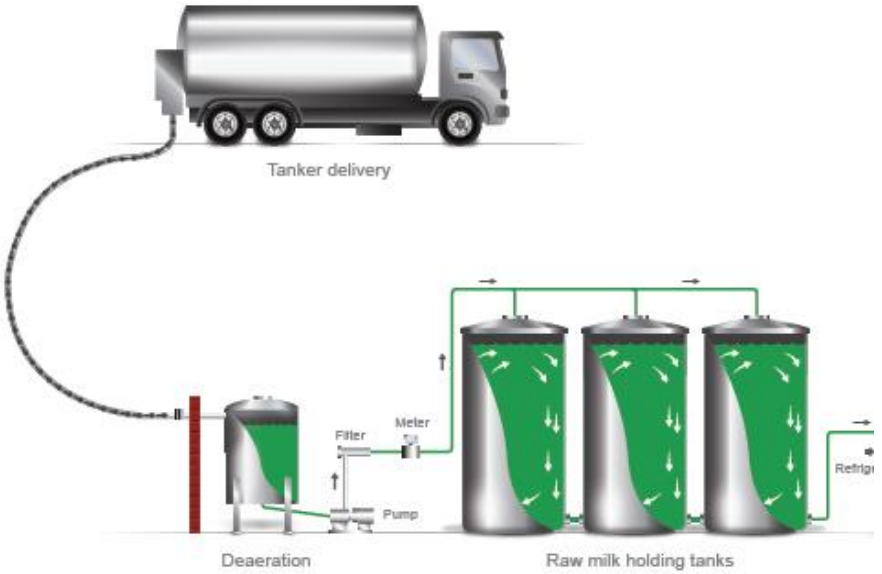
Pasteurised Milk Process

Pasteurised milk



Milk Reception





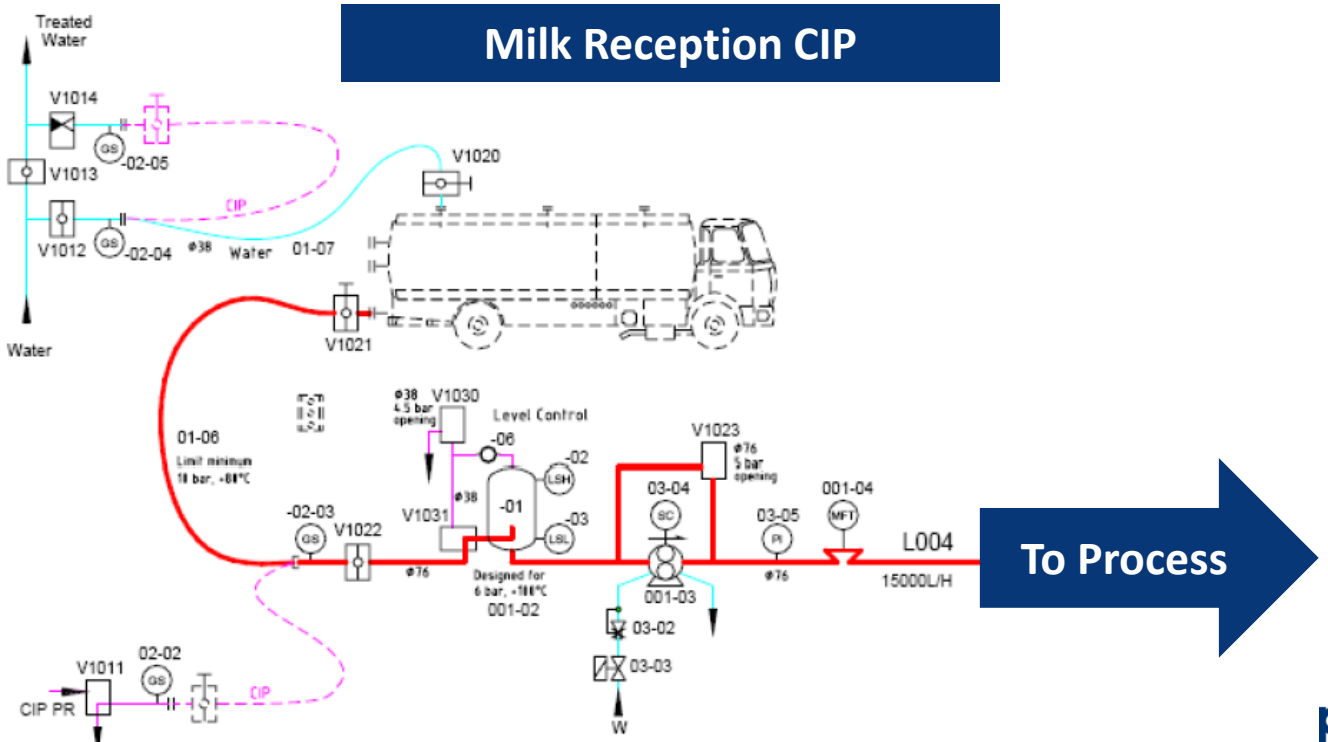
Milk Reception Opportunities

- In most countries tankers **MUST BE** cleaned both externally and internally:

- **External cleaning:**
  - Often open hoses (wasted water + effluent charge)
  - No time control on each truck clean (wasted water + effluent charge)
  - Potential opportunity to offer simple solenoid valve (PF) time control for each truck clean
  - Saves water + effluent. Could quite easily justify the cost!

Milk Reception Opportunities

- Internal Clean In Place (CIP):
  - Trucks have internal CIP process
  - Often all goes to drain
  - Potential opportunity to recover low grade heat (discuss later)

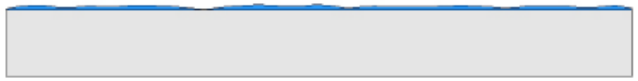


Water Flow Meter-ELM

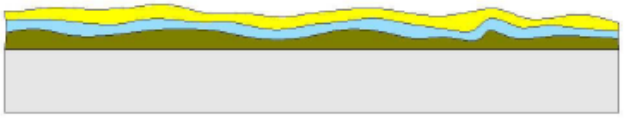
- MILK RECEPTION is a major consumer of water
- Do you meter the water?
- Monitoring water will save both water costs and effluent costs.

Cleaning in Place (CIP)

Cleaning Different Process Applications

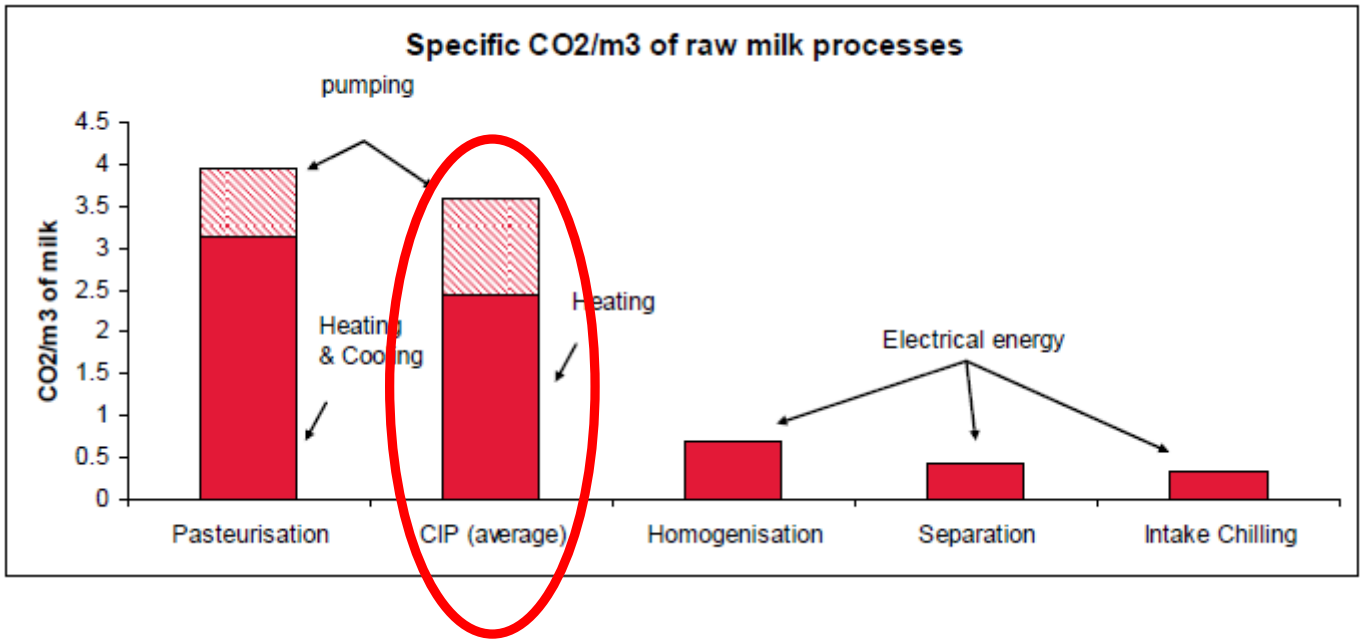


Cold surface: Milk reception systems, raw milk, storage tanks, pipes soiled by milk froth.



Hot surface: Pasteurisers, process tanks, pipes, etc.

Energy Consumption of Raw Milk CIP

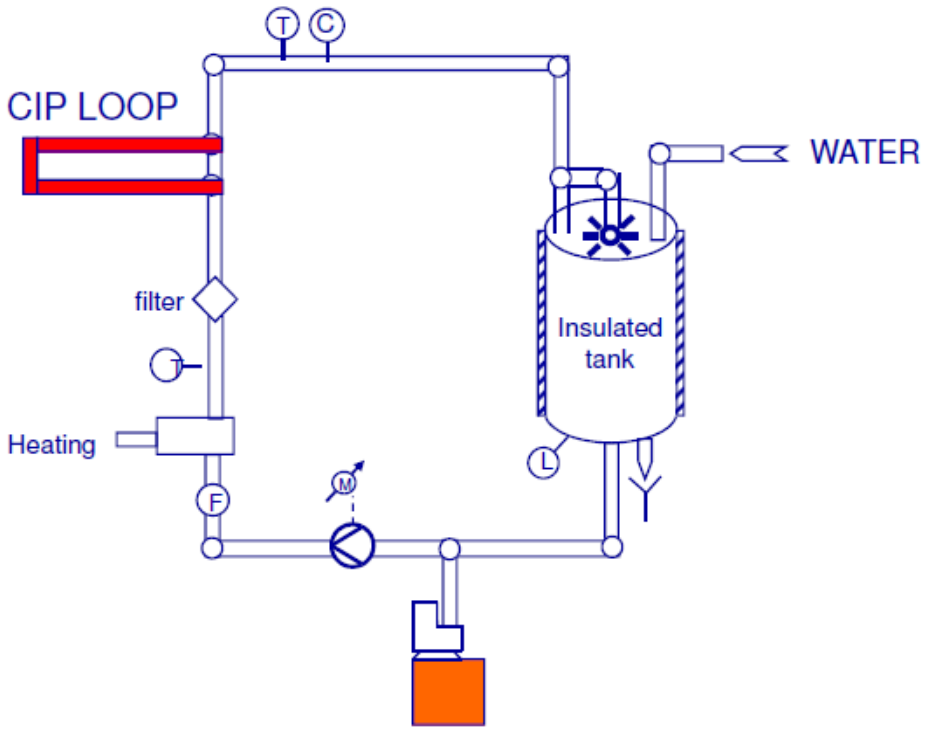


- Large proportion of overall energy consumed in raw milk processing is used in Cleaning in Place (CIP) process.

Types of CIP – Single Use

- Single-use system: cleaning solution is used only once and discharged to drain after use → single tank

Example:



(+)
-Simple, not very costly installation
-Could be applied for:
- -Small installations (decentralized CIP system)
- -Processes where cross-contamination is a concern
- -Heavy soiled equipments

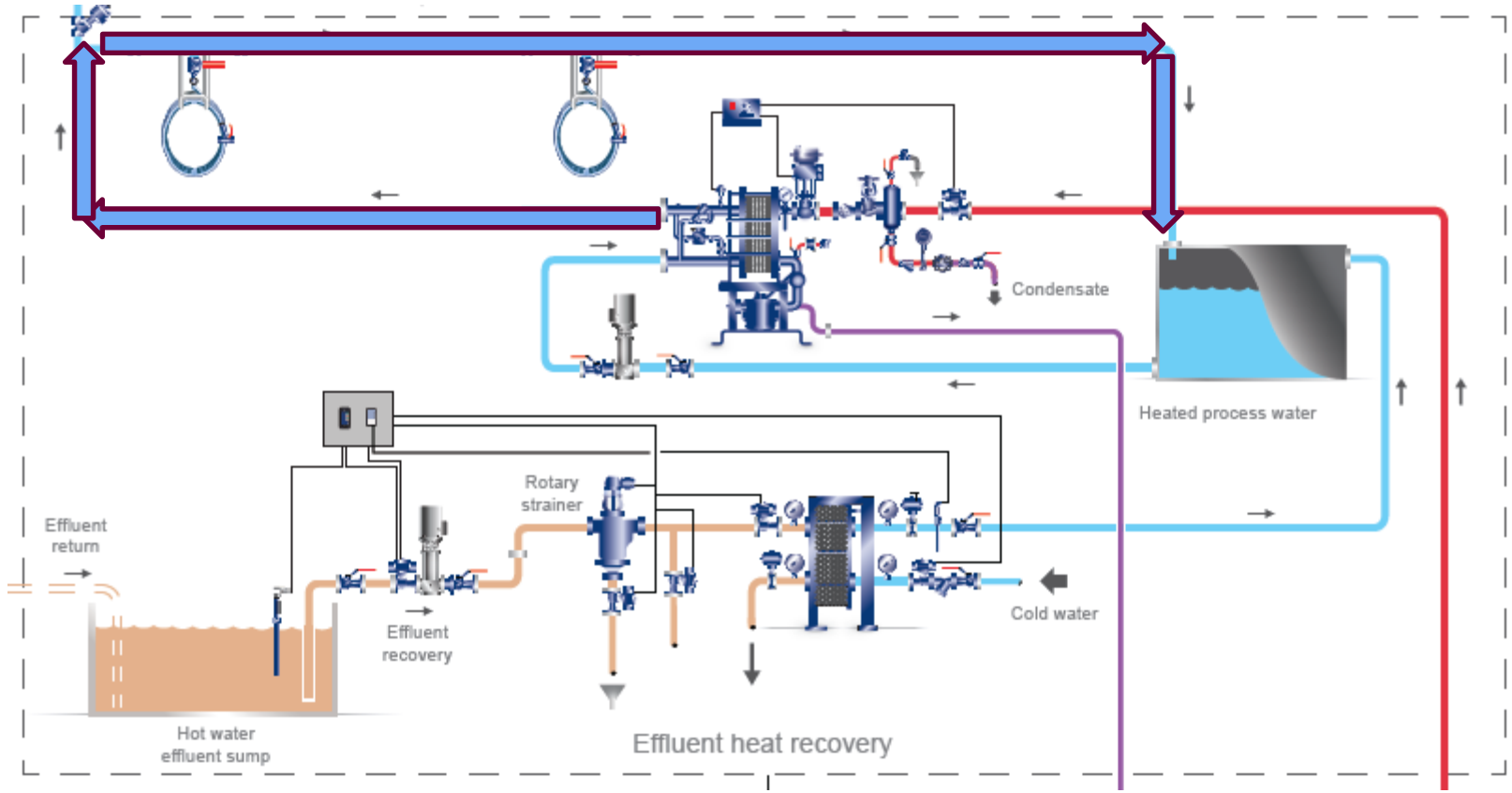
(-)
-High operational costs
-Environmental impact

Solutions for Heat Recovery in CIP

- **Single Use:**
  - All heat and water goes to drain
  - Contaminated
- Depending upon volume and distance we could recover the heat content from the CIP for various uses:
  - Preheat boiler feedwater
  - Preheat CIP water
  - Preheat process water

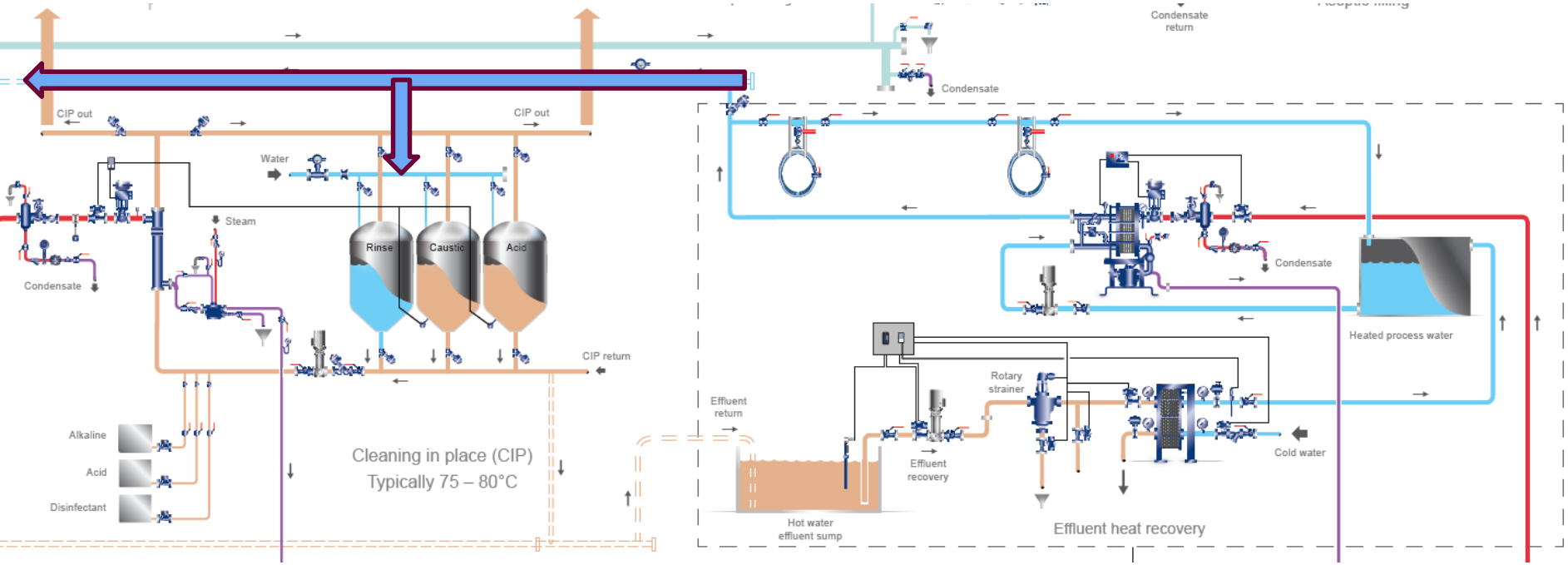
⇒ rinsing with water 40°C	– 10 min
⇒ acid solution circulation 70°C	– 10 min
⇒ rinsing with cold water	– 5 min
⇒ alkaline solution circulation 75°C	– 25 min
⇒ rinsing with water 30°C	– 5 min
⇒ acid solution circulation 70°C	– 15 min
⇒ rinsing with cold water	– 5 min
⇒ disinfection with chemical detergent	– 10 min
⇒ rinsing with cold water	– 5 min
⇒ disinfection with hot water 98°C	– 10 min

Effluent Heat Recovery



- Waste heat used for washdown water/circuit

Effluent Heat Recovery

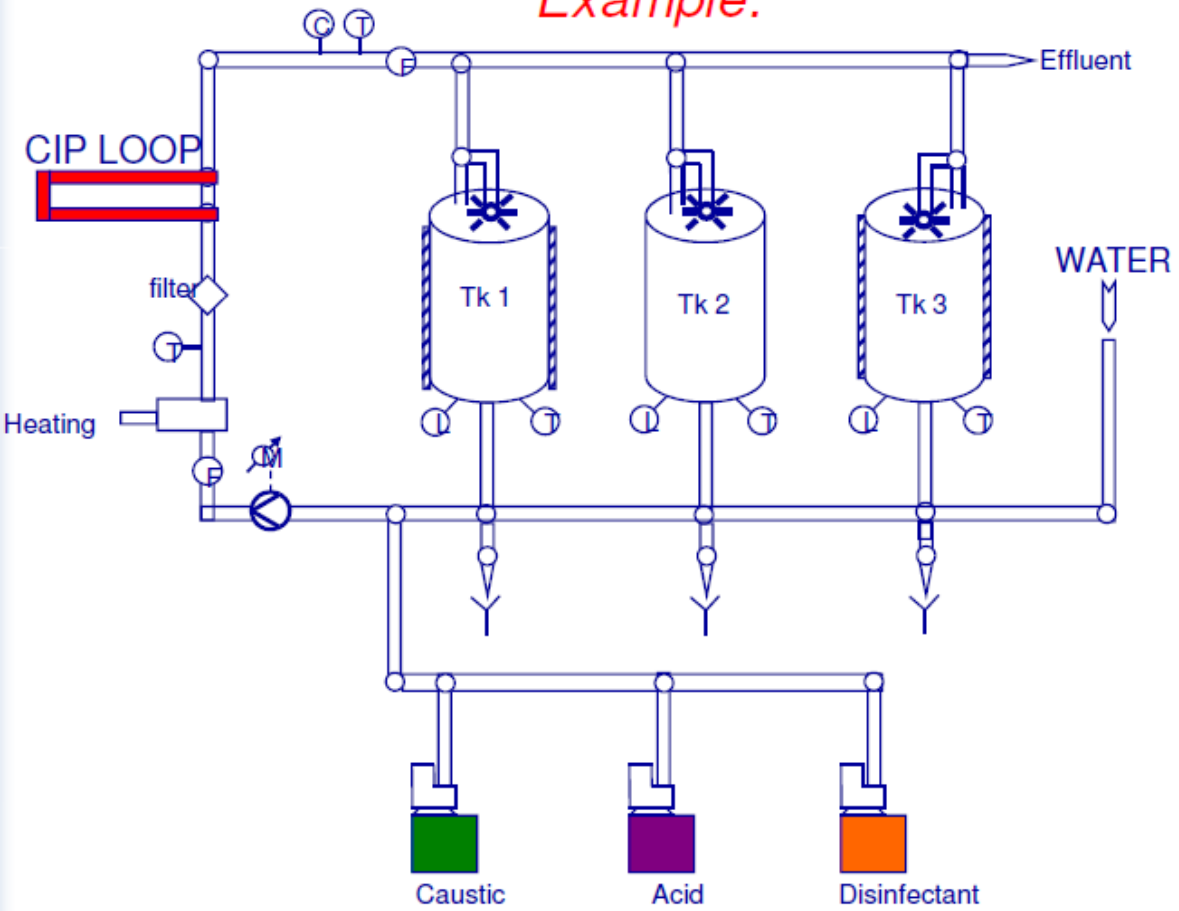


- Waste heat used for CIP make-up water

Types of CIP – Full Recovery System

- **Re-use system:** the same cleaning solution is used for a large number of cleaning operations (recover & reuse) → multi-tanks **(3)**

Example:



(+)

- Lower operational costs
- Lower environmental impact
- Could be applied to large or centralised CIP systems

(-)

- Installation can be complex and very costly

Solutions for Heat Recovery in CIP

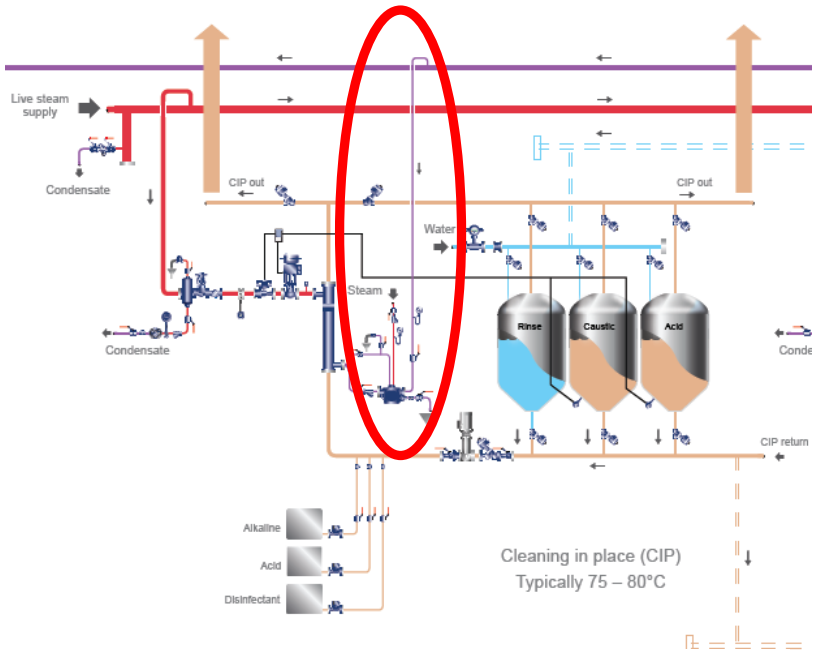
- Customer could operate centralised or de-centralised CIP systems
- Site could have 10 – 20 CIP systems on each site, if de-centralised
- Establish what type of CIP system is being used for **each application.**
- Do you operate Single Use or Full Recovery System (may change from location to location)

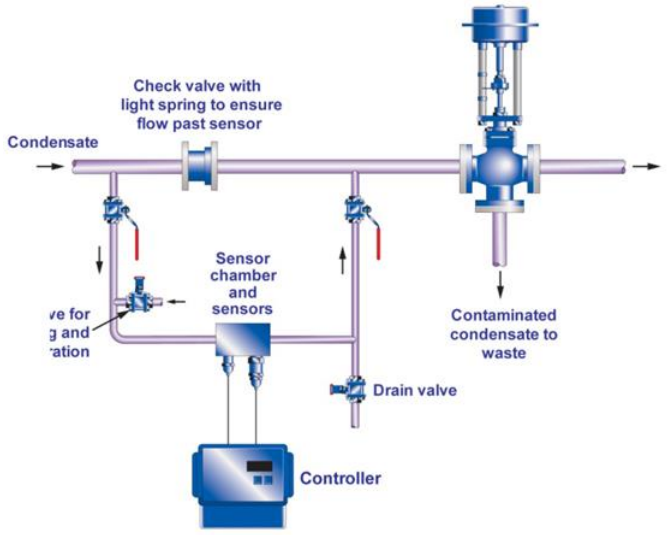
CIP – Condensate Return

- Condensate may not be returned due to fear of contamination!

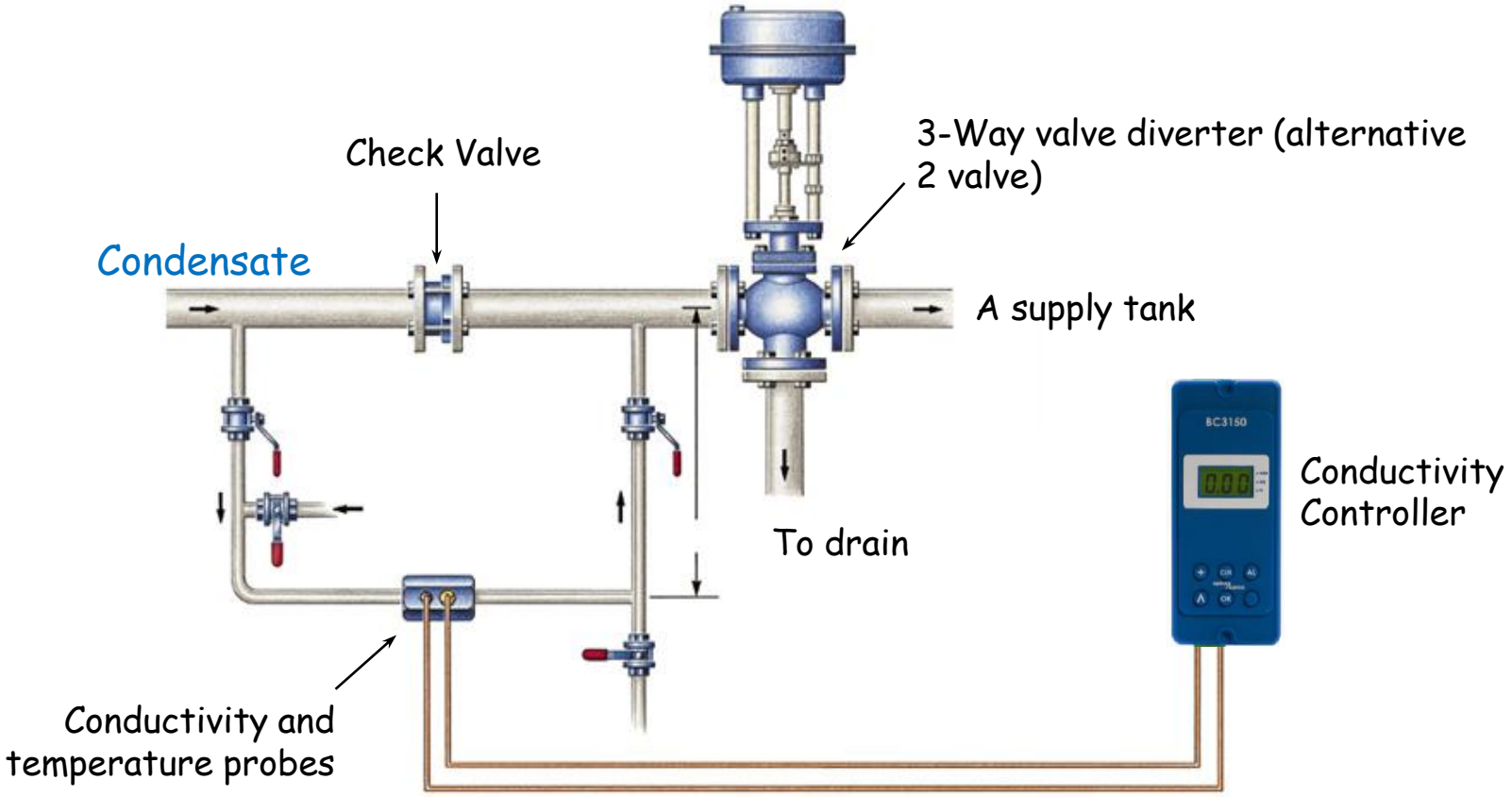
- Two Solutions:
  1. Return condensate but use CCD to detect contamination.
     - APT-pumps
     - CCD + Controls

  2. If customer does not want to run the risk, then take out the heat to pre-heat incoming CIP make-up.
     - Heat exchange package





Contaminated Condensate : CCD



Water Meter -ELM

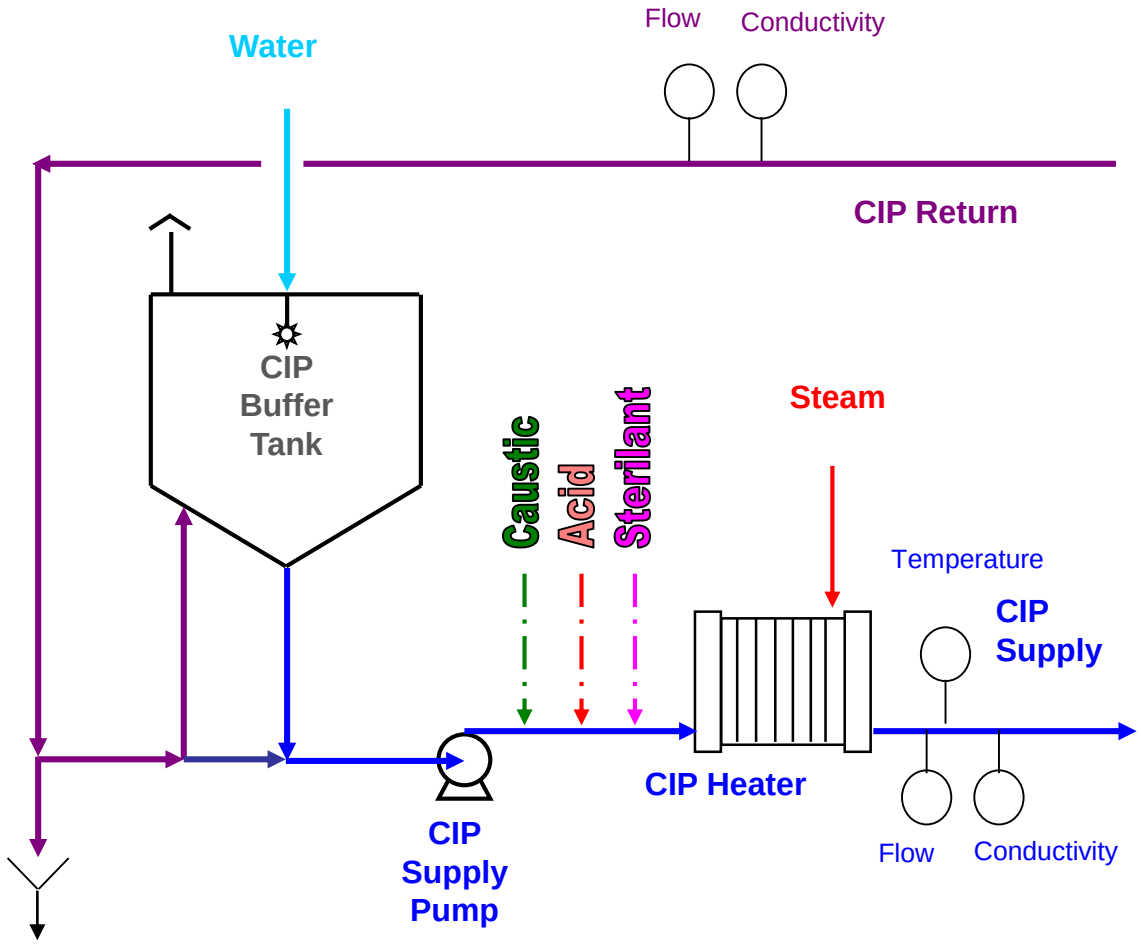
- CIP is a major consumer of water
- Often no meters fitted
- Monitoring water will save both water costs and effluent costs.

CIP Solutions

Few simple questions:

- **What type of system does the customer use?**
- **How often do they CIP?**
- **Approximate water consumption?**
- **How much is going to drain and at what temperature?**
- **Often the customer is unaware since it is automatic and you never see the waste!**

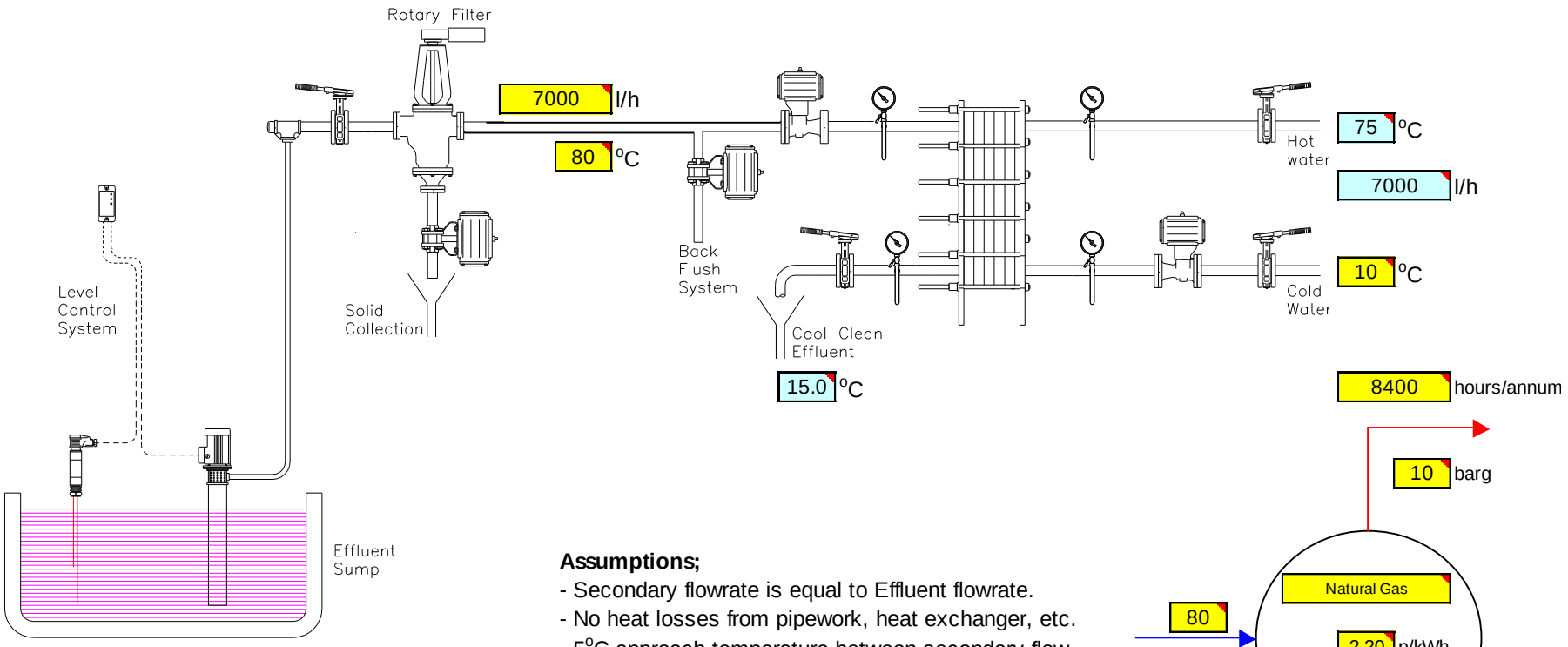
Estimate the heat loss and cost, using configurator.



First for Steam Solutions

Effluent Configurator

ANNUAL FUEL SAVING (kWh):	5,555,170.83
ANNUAL CO_2 EMISSIONS SAVING (tonnes):	1,055.48



Assumptions;

- Secondary flowrate is equal to Effluent flowrate.
- No heat losses from pipework, heat exchanger, etc.
- 5°C approach temperature between secondary flow temperature and effluent temperature.
- Calculations are conservative due to actual process pressure and condensate return temperature not being known (calculations based on boiler generation pressure and feedwater temperature).

Cost of steam: 18.69 **£/1000 kg**

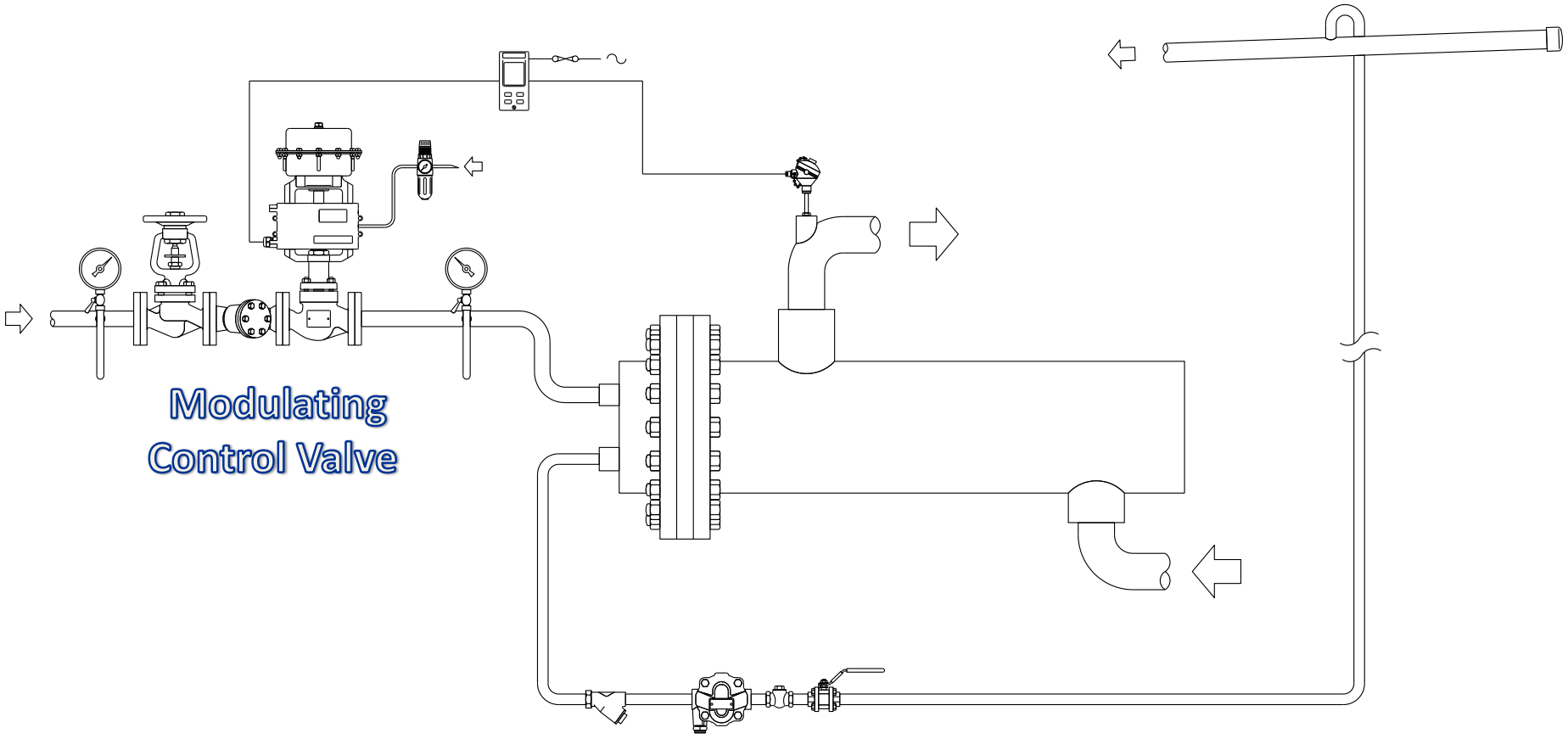
First for Steam Solutions

Products from Spirax-Sarco for CIP

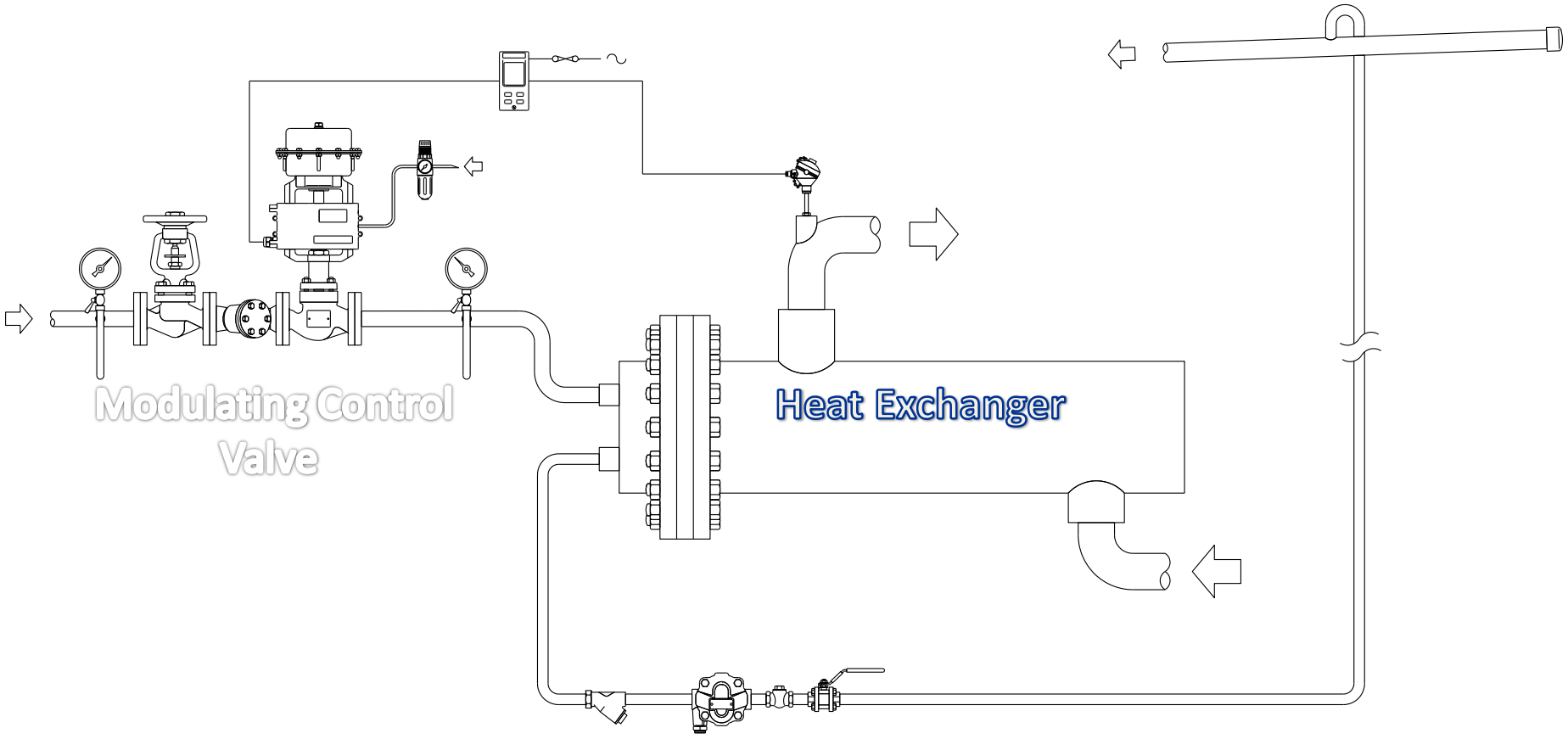
First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

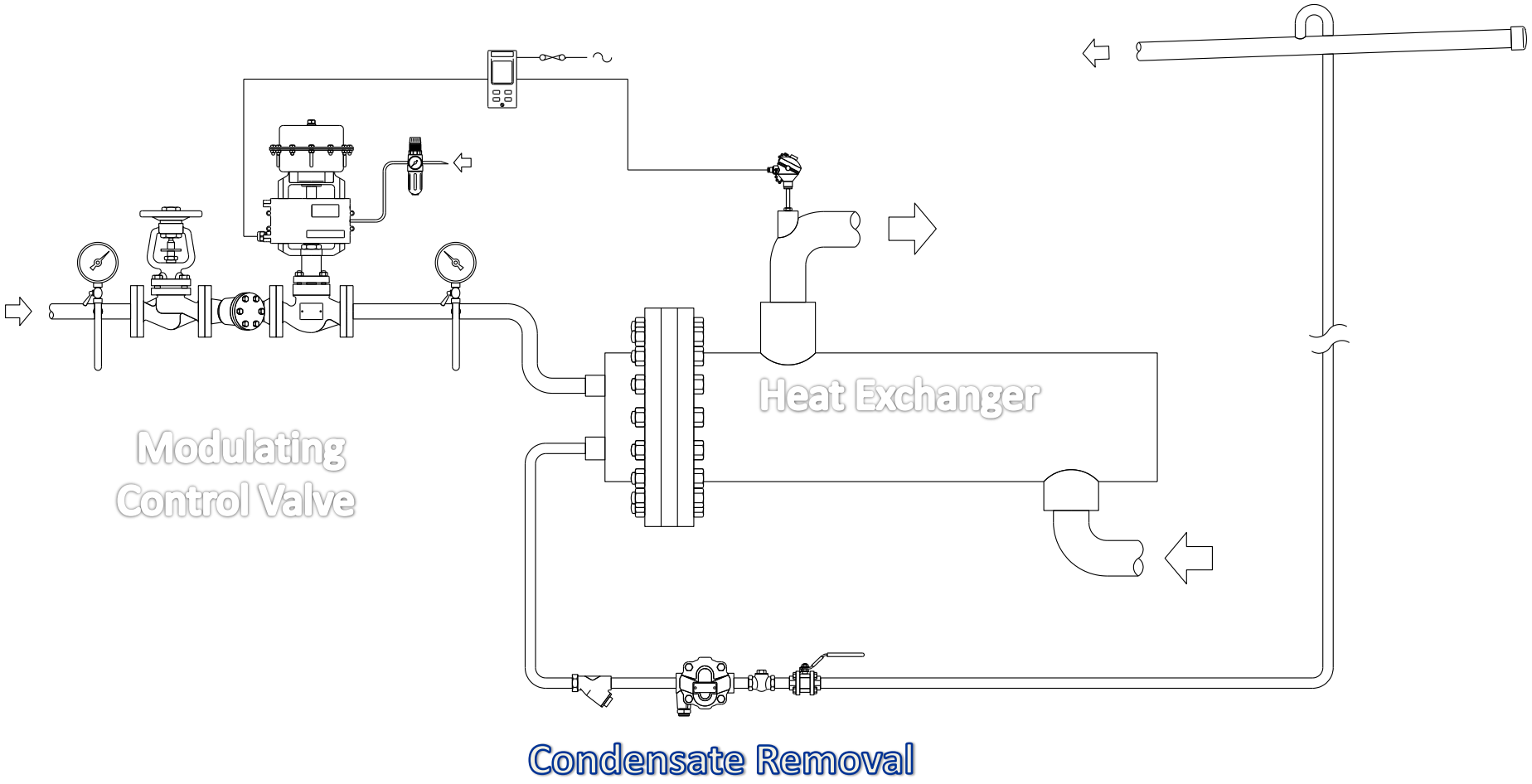
Heating System – By Parts



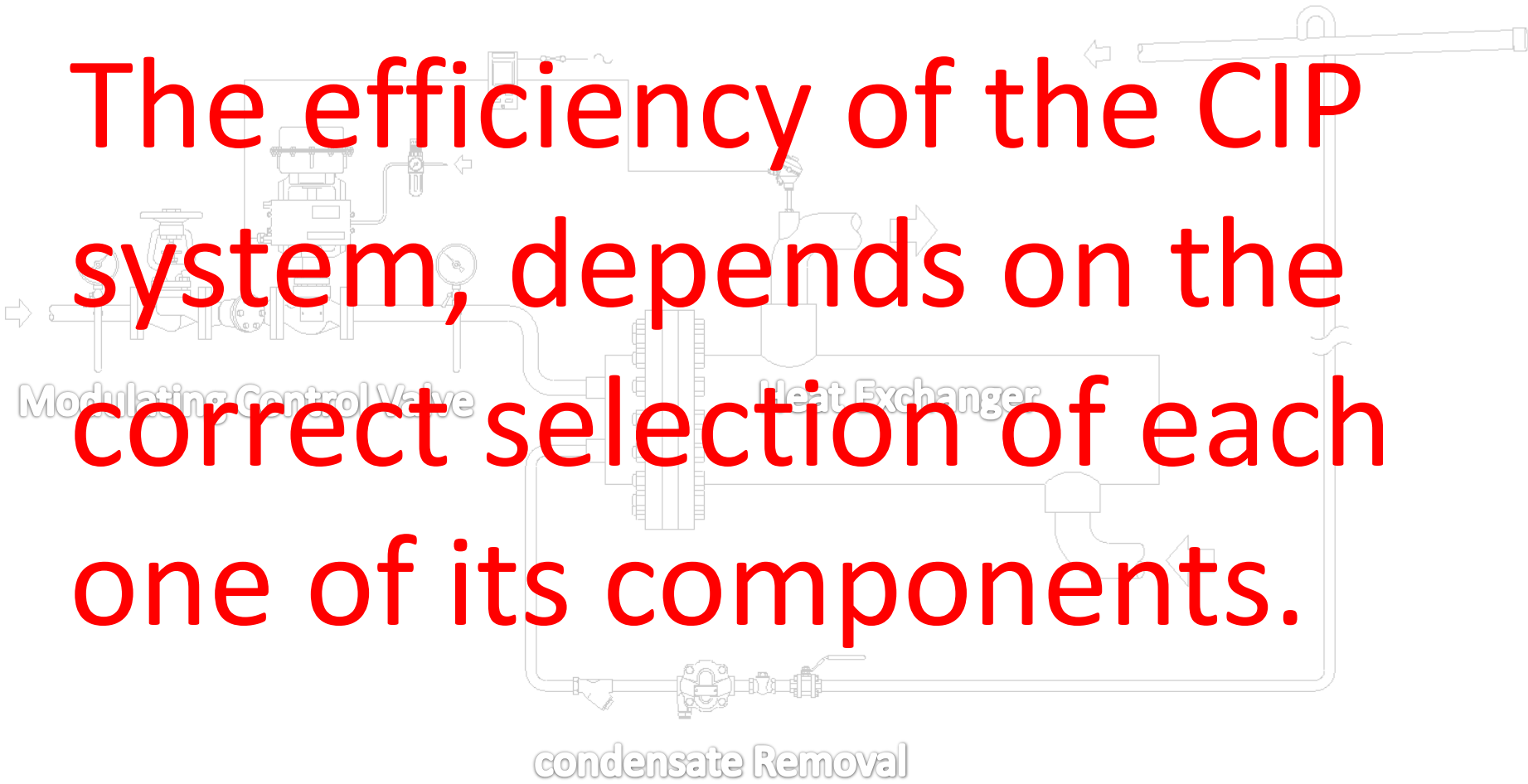
Heating System – By Parts



Heating Systems – By Parts

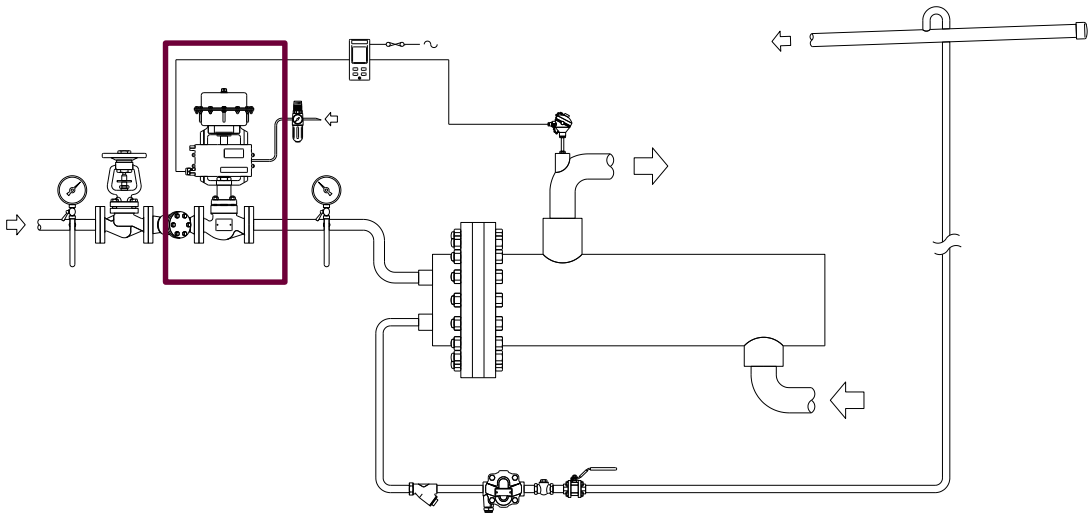


Heating System – By Parts



The efficiency of the CIP system, depends on the correct selection of each one of its components.

Modulating Control Valves



Modulating Control Valves: SPIRA-TROL

General Service Application

+

Precise Control

+

High Performance Steam Sealing

+

Long Lasting Internal Parts

+

Reduced number of Components

+

Quick and Easy Maintenance

=

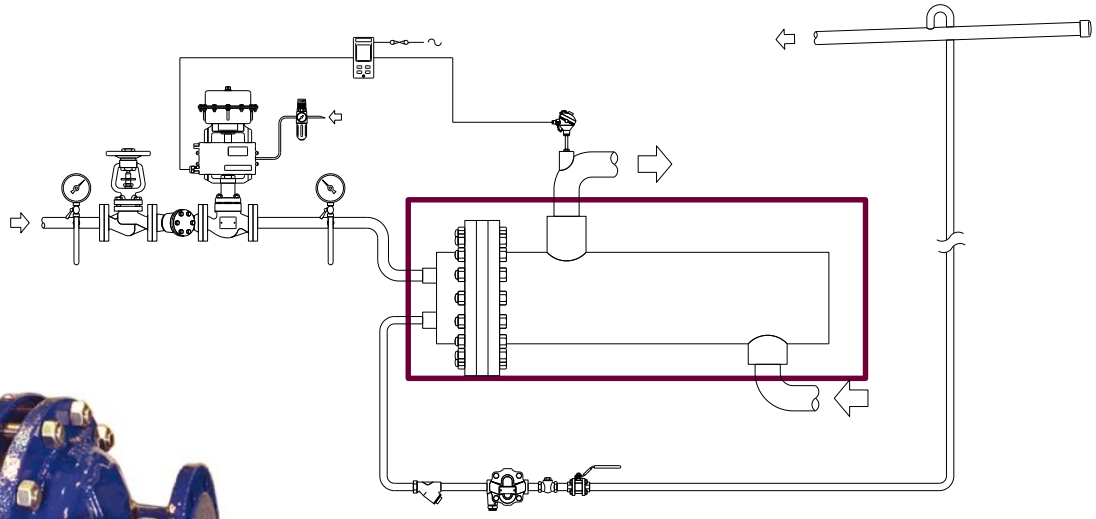
Low cost of ownership!

Electromagnetic Smart Positioner

Easy to commission!

Minimum air consumption

Heat Exchanger



Turflow Heat Exchange Solutio

Ideal for Cleaning in Place CIP applications):

- High efficiency - Corrugated tube design improves the heat transfer rate and promotes a self-cleaning effect.
- Minimal downtime - self cleaning effect reduces scale build up, resulting in lower maintenance.
- Reliability and longevity - manufactured from high quality stainless steel.
- Flexible space-saving installation - Turflow heat exchangers are compact units that can be fitted either horizontally or vertically.
- **Reduced Total Cost of Ownership**

Benefits of Turflow®

Corrugated HE Tube

Turbulant Flow

- **Higher Reynolds**
- **Better heat transfer**

Smooth HE Tube

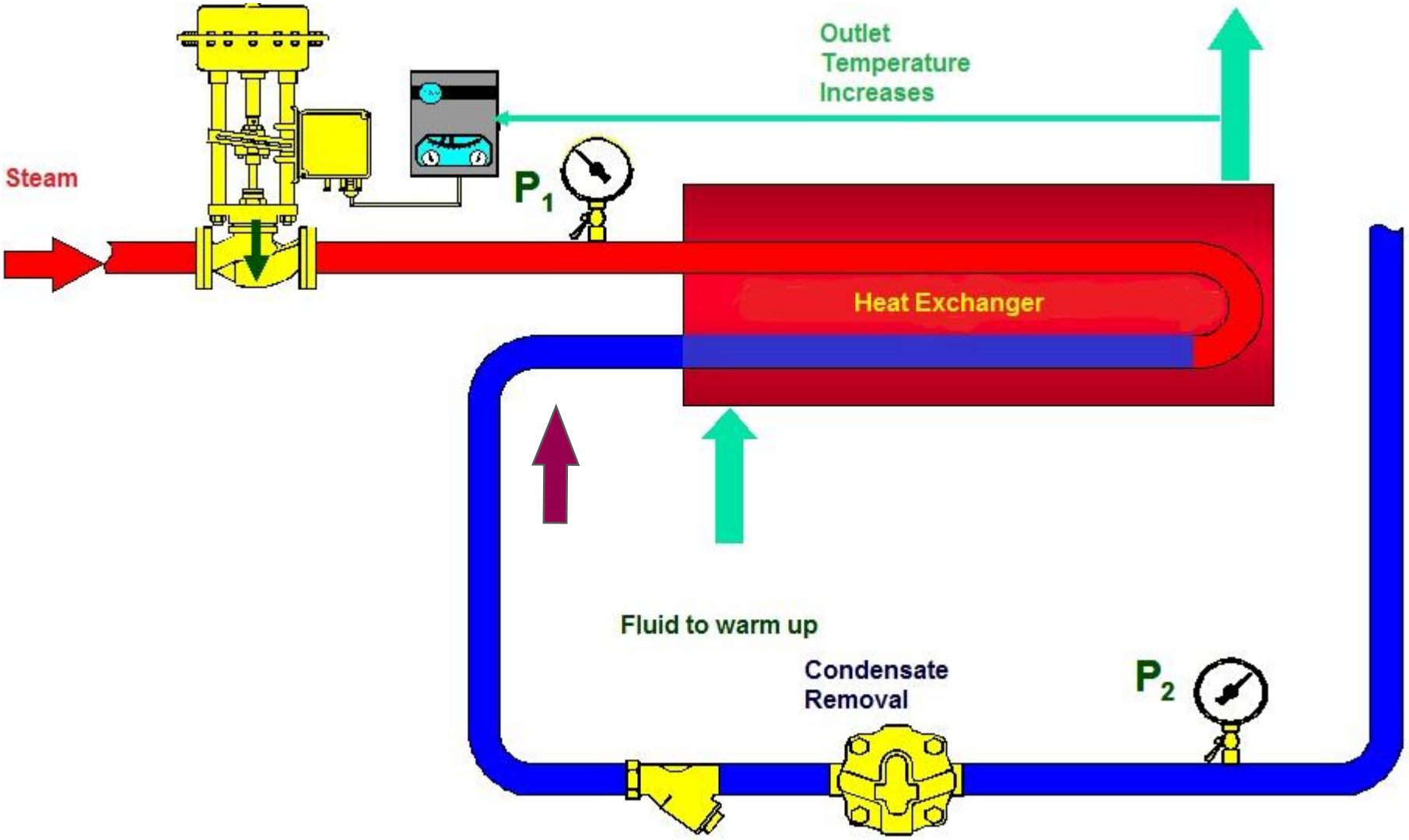
Laminar Flow

- **Lower Reynolds**
- **Less efficient heat transfer**

Heat Exchanger Performance

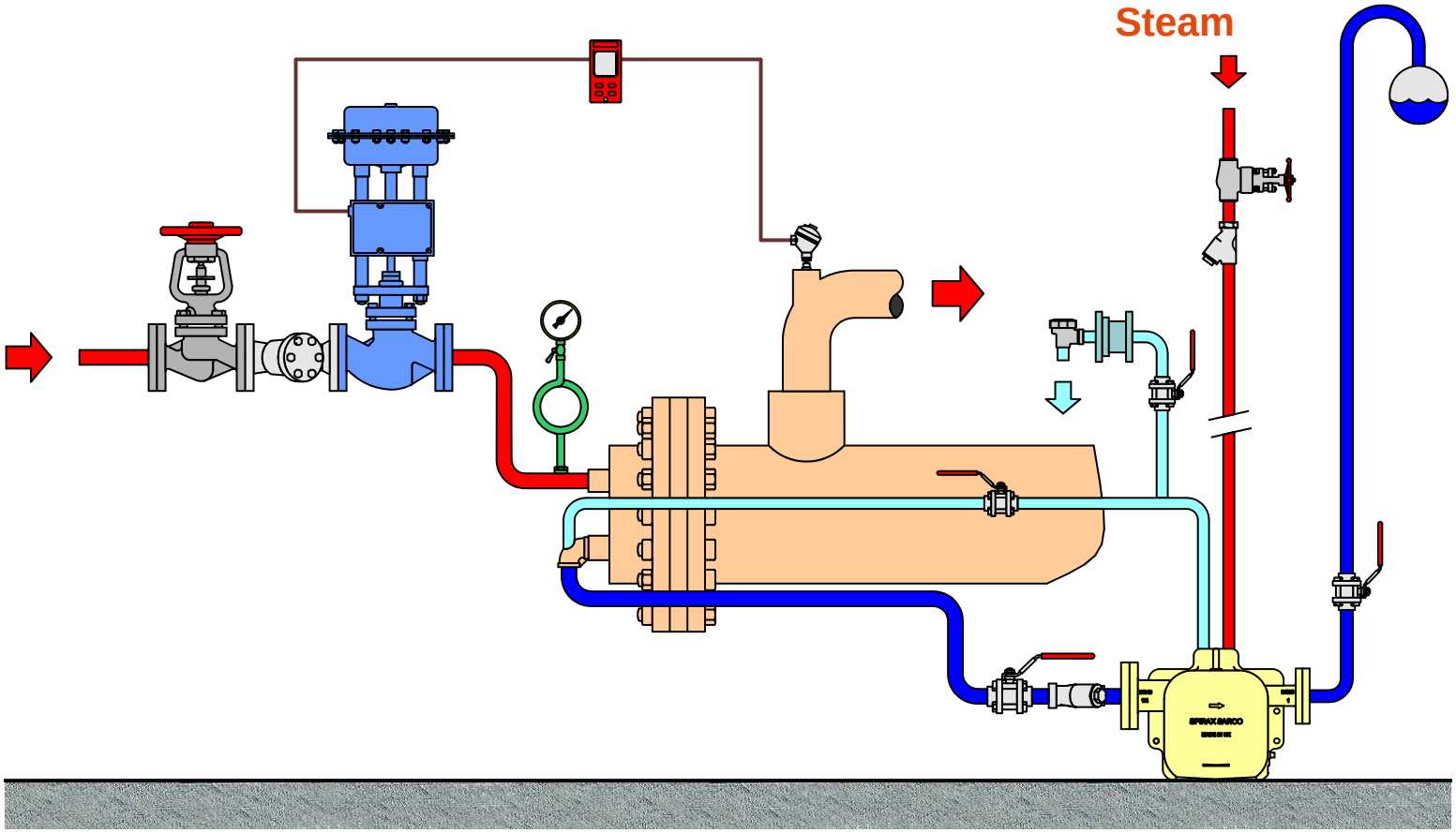
- What is the condition of your Heat Exchangers?
- When were the heat exchangers last maintained?
- How often are they checked?

Heat Exchanger Stall

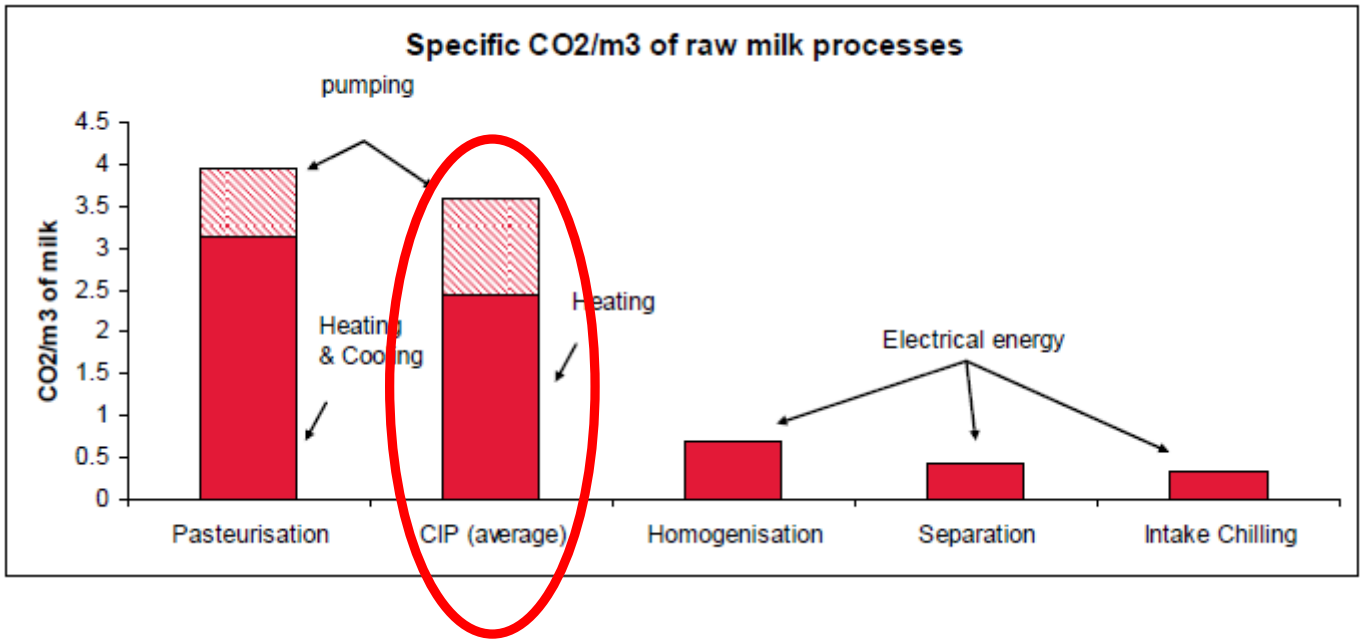


spirax sarco

Solution: Automatic Pumps



Energy Consumption of Raw Milk CIP

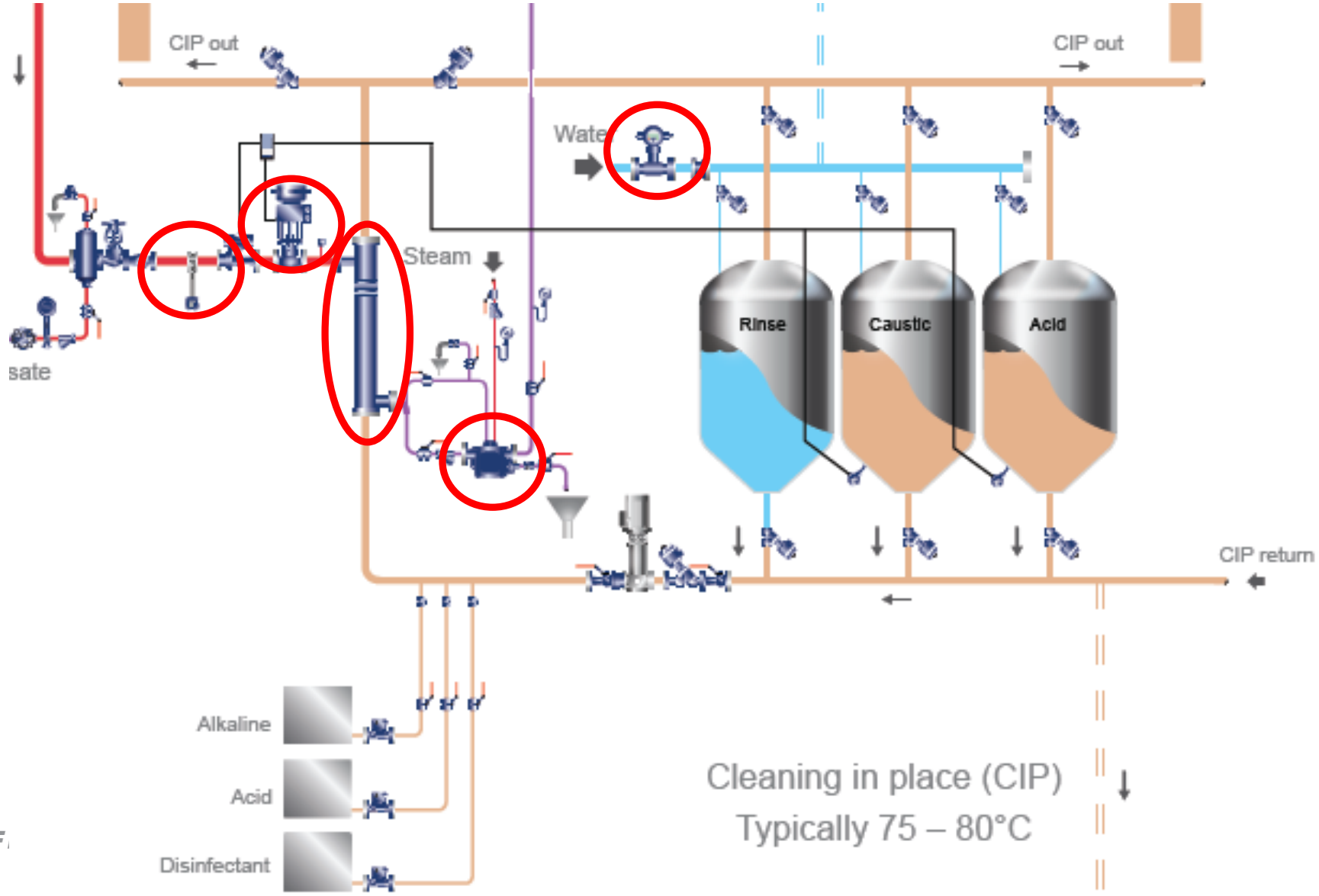


- Large proportion of overall energy consumed in raw milk processing is used in Cleaning in Place (CIP) process.

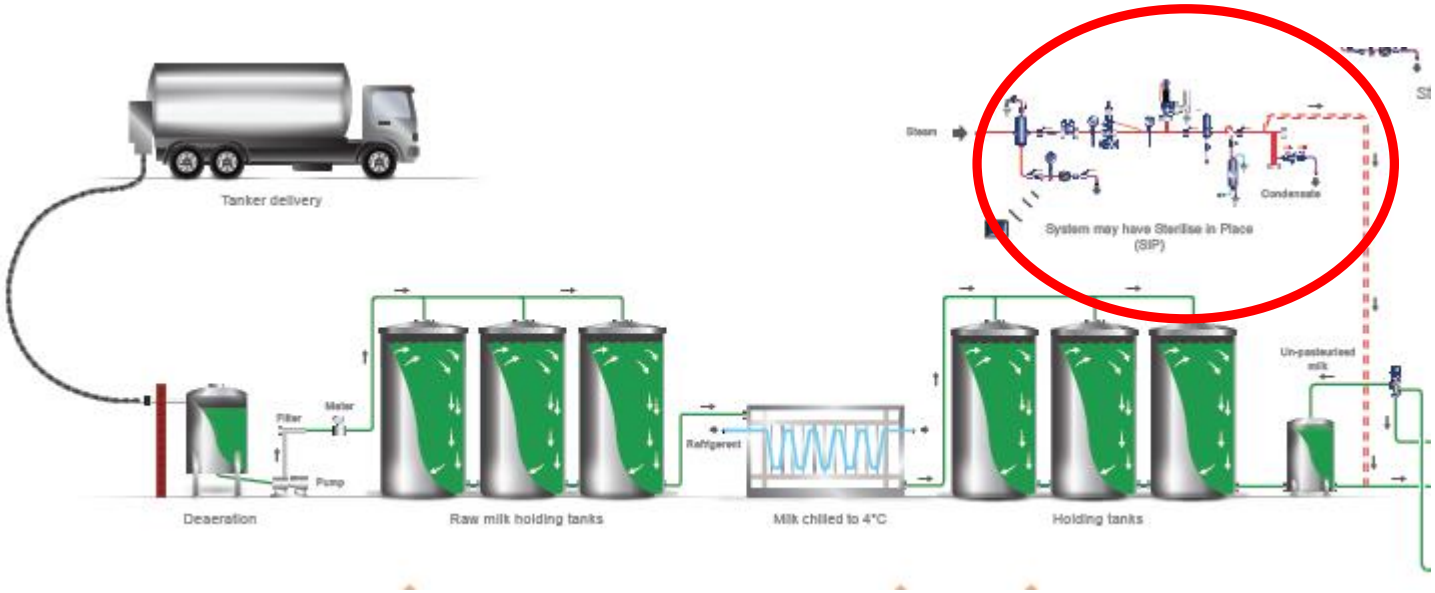
Targeting & Monitoring

- Steam Meter could be installed on each CIP stations
- Estimate of steam consumption for each CIP station will determine viability!

CIP – Spirax-Sarco Products

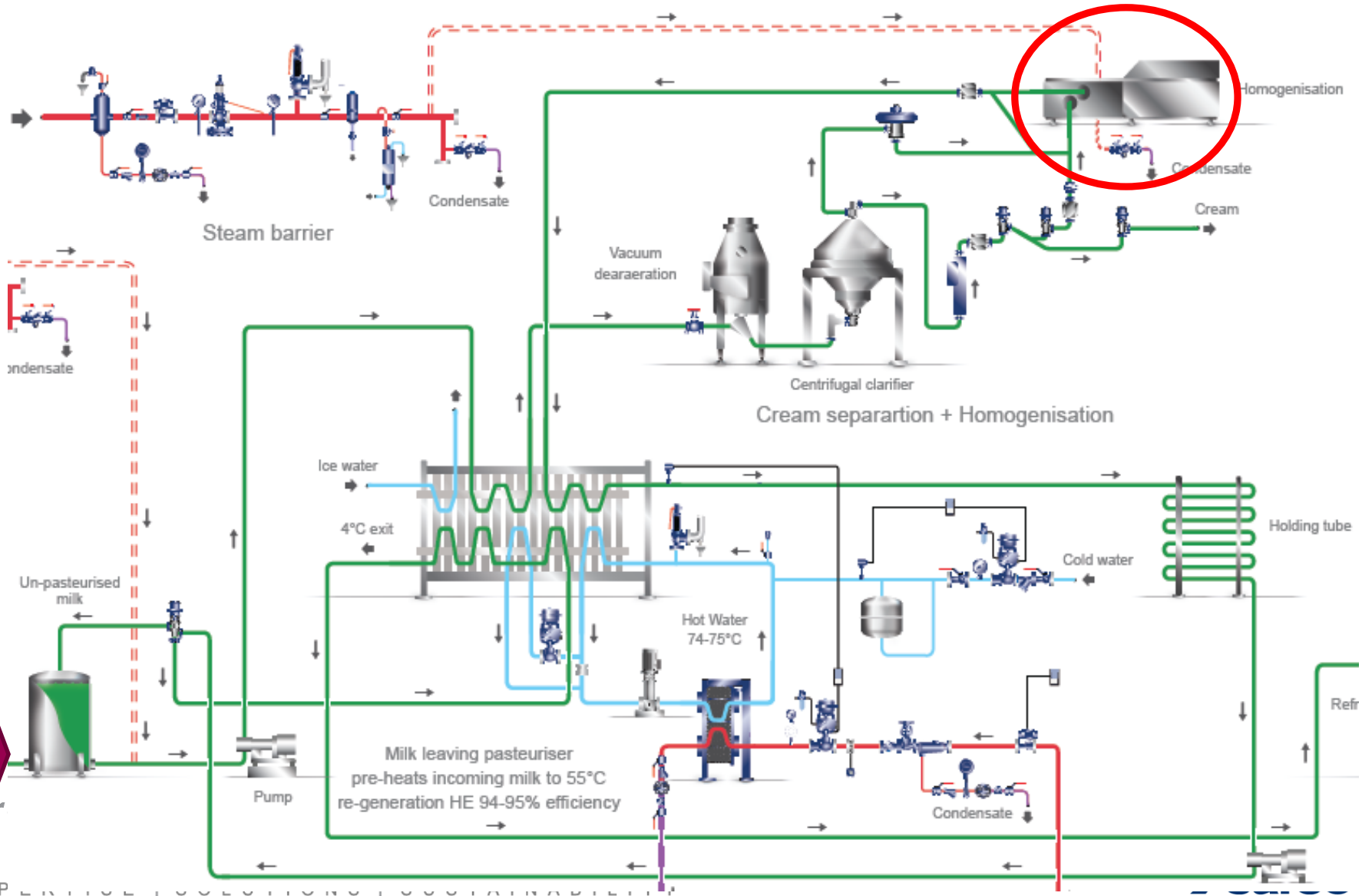


Solutions for Pasteurised Milk

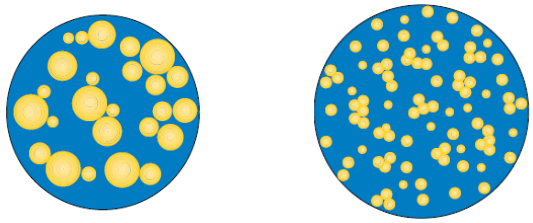


- Milk is chilled after holding tanks
- In addition to Cleaning in Place (CIP) the tanks and pipework may also be Sterilised using steam in direct contact with the 'process pipe/equipment' (Sterilised in Place – SIP).
- We have covered opportunities around "Steam Quality"

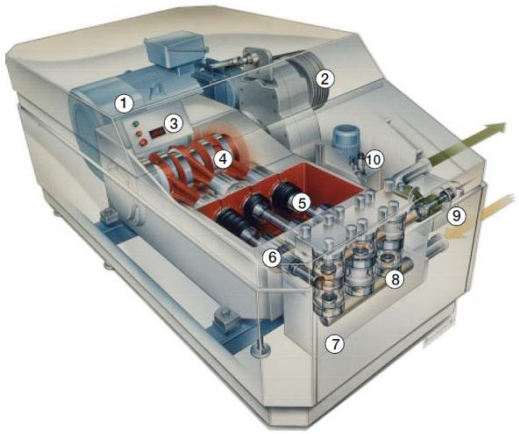
Pasteurisation



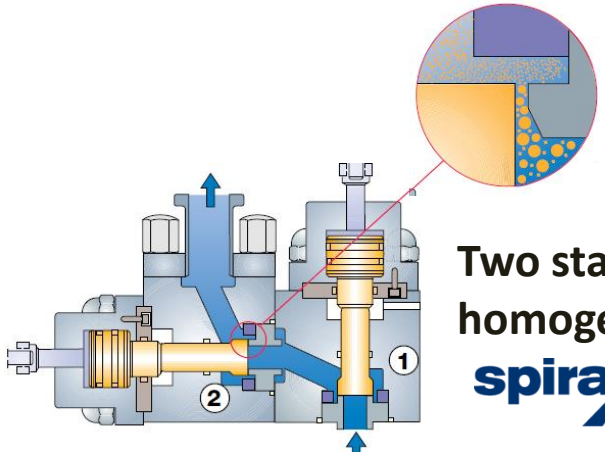
Homogenisation



- Homogenisation stabilises the fat content of milk by breaking the fat globules into much smaller ones.
- All homogenisation is done mechanically by forcing milk through a small passage at high velocity.
- Homogenisation is carried out at 55-80°C between 100 – 250 barg.
- Result is the fat globules reduced to 1µm in diameter.

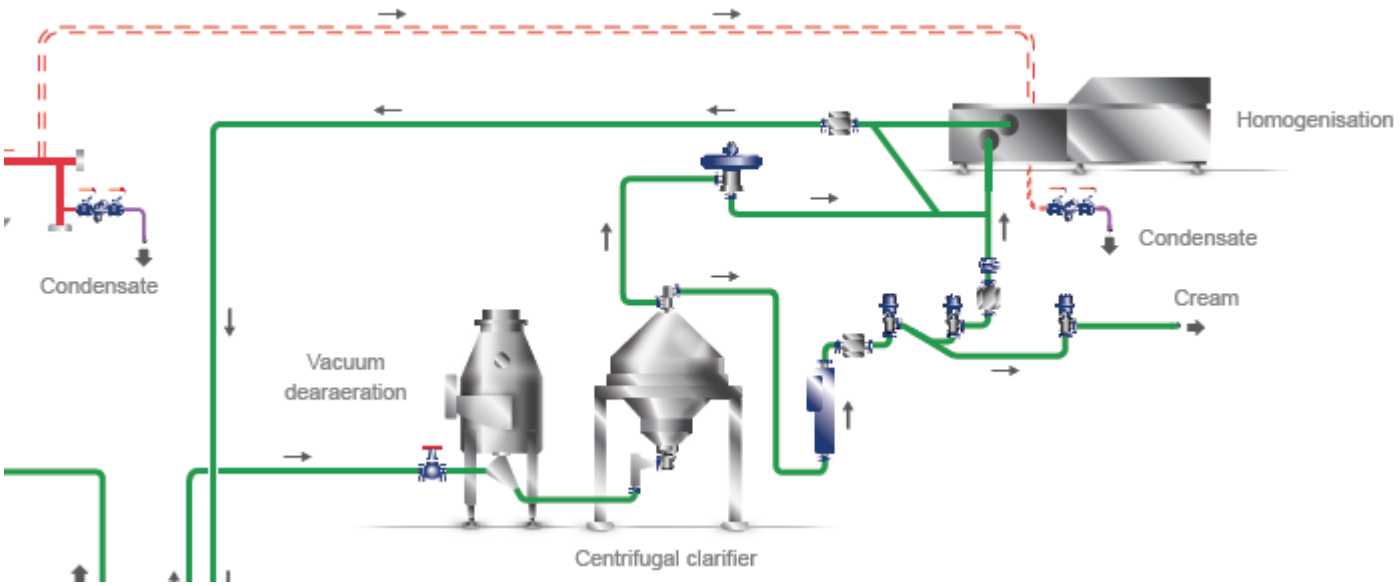


1 Main drive motor
2 V-belt transmission
3 Pressure indication
4 Crankcase
5 Piston
6 Piston seal cartridge
7 Solid stainless steel pump block
8 Valves
9 Homogenising device
10 Hydraulic pressure setting system



Two stage homogeniser

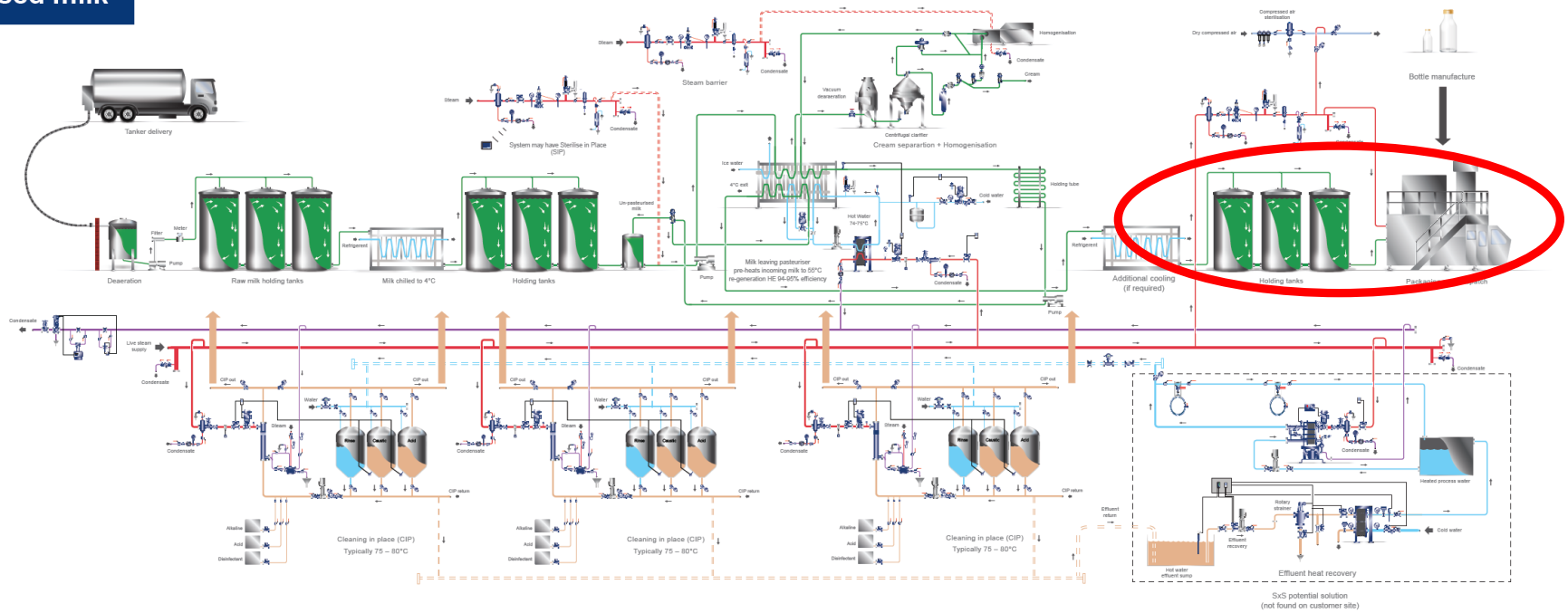
Homogeniser – Steam/Water Barrier



- Sometimes steam or hot water (70-80°C) is used as a sterile seal.
- This is often sent to drain, water seal is approximately 100 l/hr.

Packing and Despatch

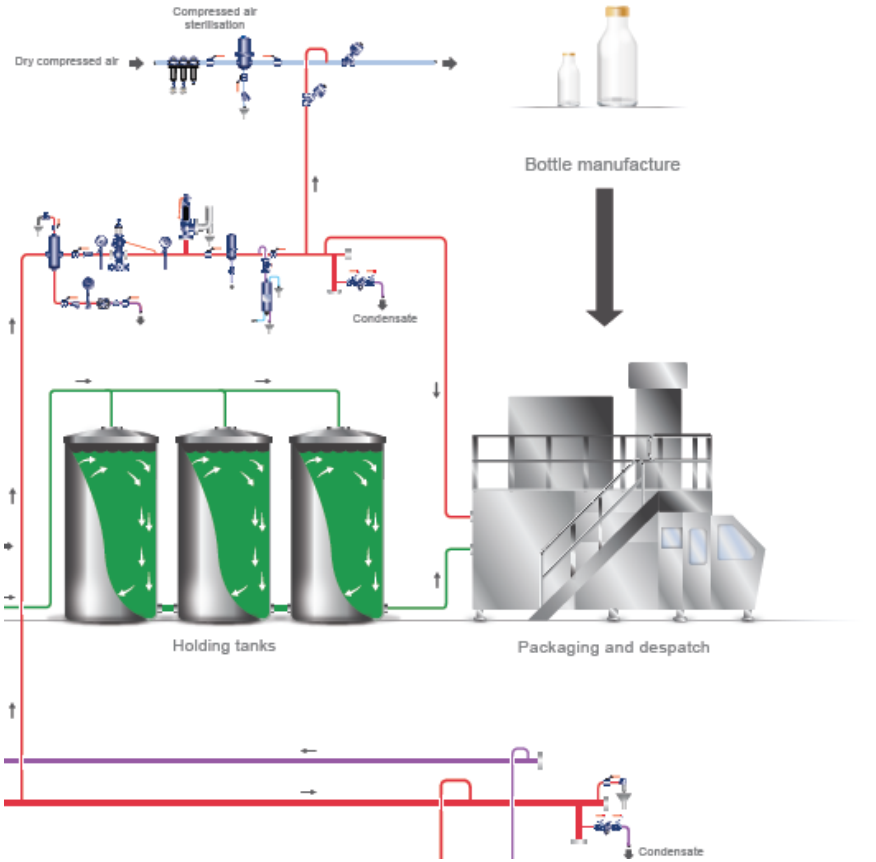
Pasteurised milk



- Pasteurised milk is sent to holding tanks before packaging and despatch.
- Steam is often used to sterilise most filling heads (Steam Quality!)
- Steam is often used to sterilise compressed air line (Steam Quality!)

Sterilisation of Clean Air

- Opportunities for steam quality discussions for both:
  - Sterilise in Place (SIP) of filling heads
  - Sterilisation of clean air filters



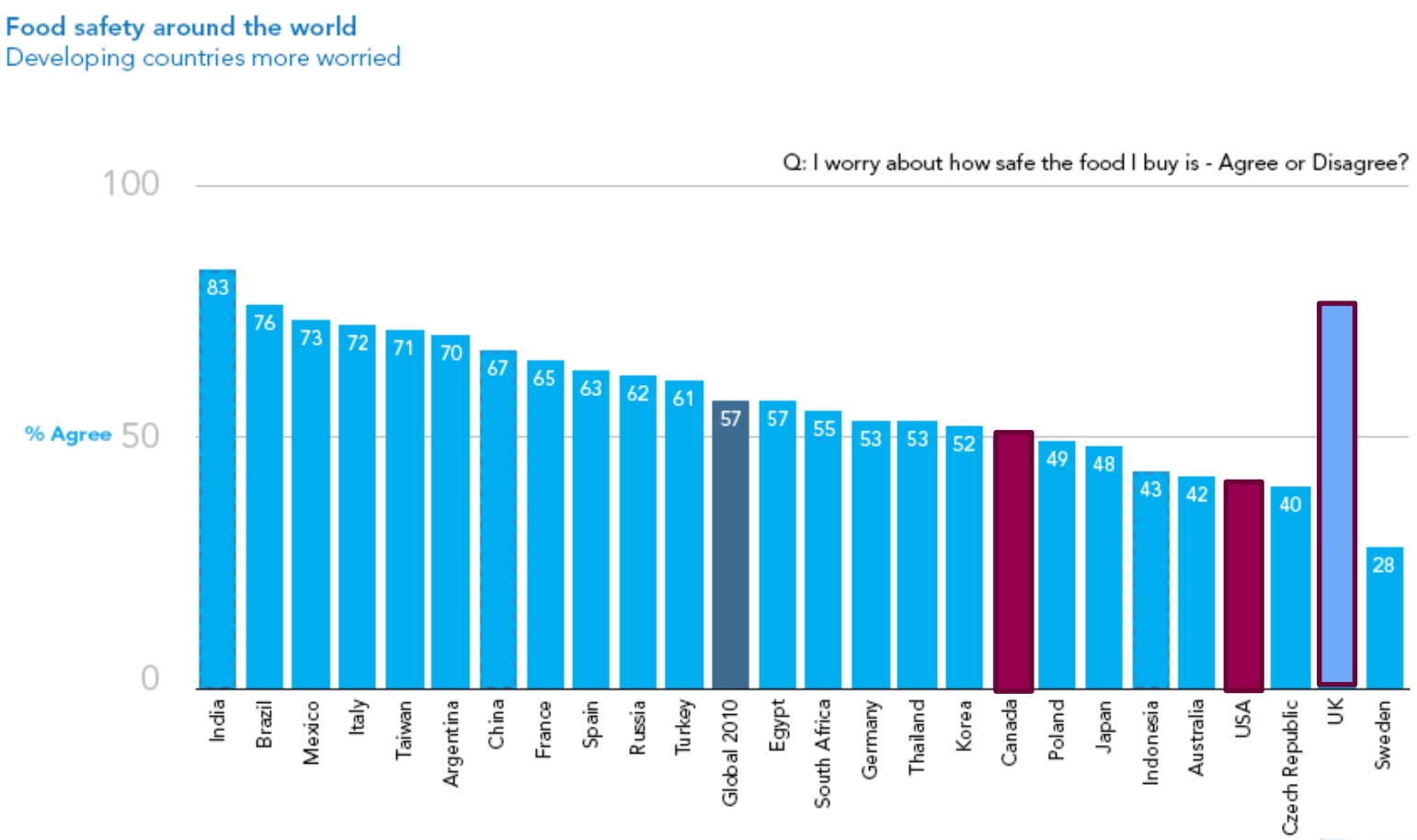
Steam Quality in Dairy Industry

Customer Requirements

What do Dairy customers require at a high level?

- Consistent high quality products e.g. milk powder, UHT milk, yoghurt, etc.
- Minimised operating costs e.g. energy, water consumption, TCO, etc. (resulting in improved profitability)
- Increased production throughput (resulting in improved profitability)
- Legal compliance where legislation dictates!

Customer Concern About Food Safety



Source: Tetra Pak Dairy Index – Issue 4

Steam in Contact With Process Applications

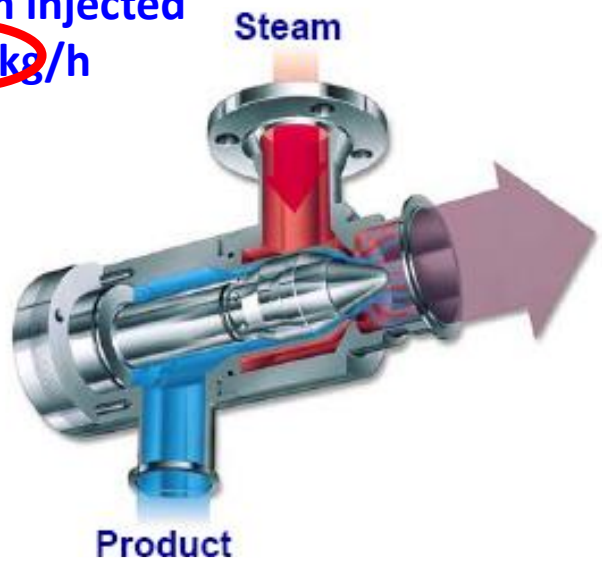
Process application list

Some typical applications where steam is in direct contact with process or products.

Steam application	Industry	Direct contact
Powdered milk	Food	✓
Steam injection for cooking sauces, soups, ready meals, etc.	Food	✓
Superheated steam for browning food	Food	✓
Steam used for pulling vacuum in jars, cans, bottles, etc.	Food	✓
Bread proving	Food	✓
Meat vapour condenser	Food	✓
Superheaters to 'puff' wheat.	Food	✓
Meat cooking, smoking & curing	Food	✓
Filling head sterilisation	Food	✓
Chicken de-feather and pre-cooking	Food	✓
Steam barrier for aseptic filling	Dairy	✓
Milk sterilisation (UHT)	Dairy	✓
Sterilising in place (SIP)	Food	✓
Sterilisation of beer barrels	Beverage	✓
Direct injection on Wort boiler (brewing)	Brewing	✓
Steam bed for producing sweets	Food	✓
Flash peeling of vegetables	Food	✓
Steaming pasta in preparation for frying	Food	✓
Pasta extrusion process	Food	✓
Steam for sterilisation of bottles	Beverage	✓
Blanching foodstuffs	Food	✓
Cheese manufacturing	Beverage	✓
Cooking shellfish	Food	✓
Steam to soften frozen fish	Food	✓
Animal rendering	Food	✓
Steam tunnels for oven chips	Food	✓
Coffee extraction	Food	✓
Noodle cooking	Food	✓

Steam Quality Dairy Applications – UHT Milk

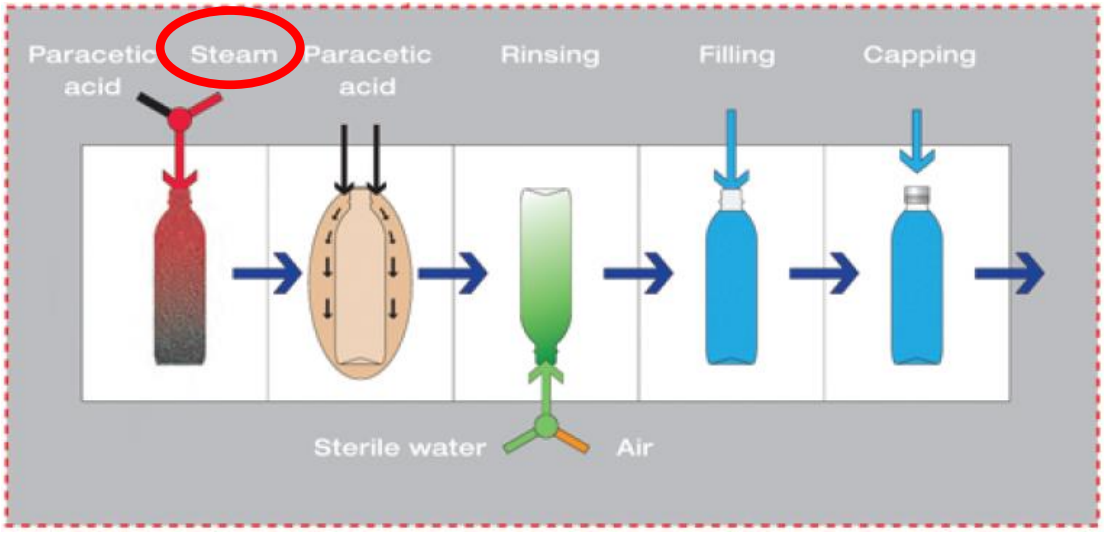
Steam injected
2000 kg/h



Product capacity of
18,000 l/h

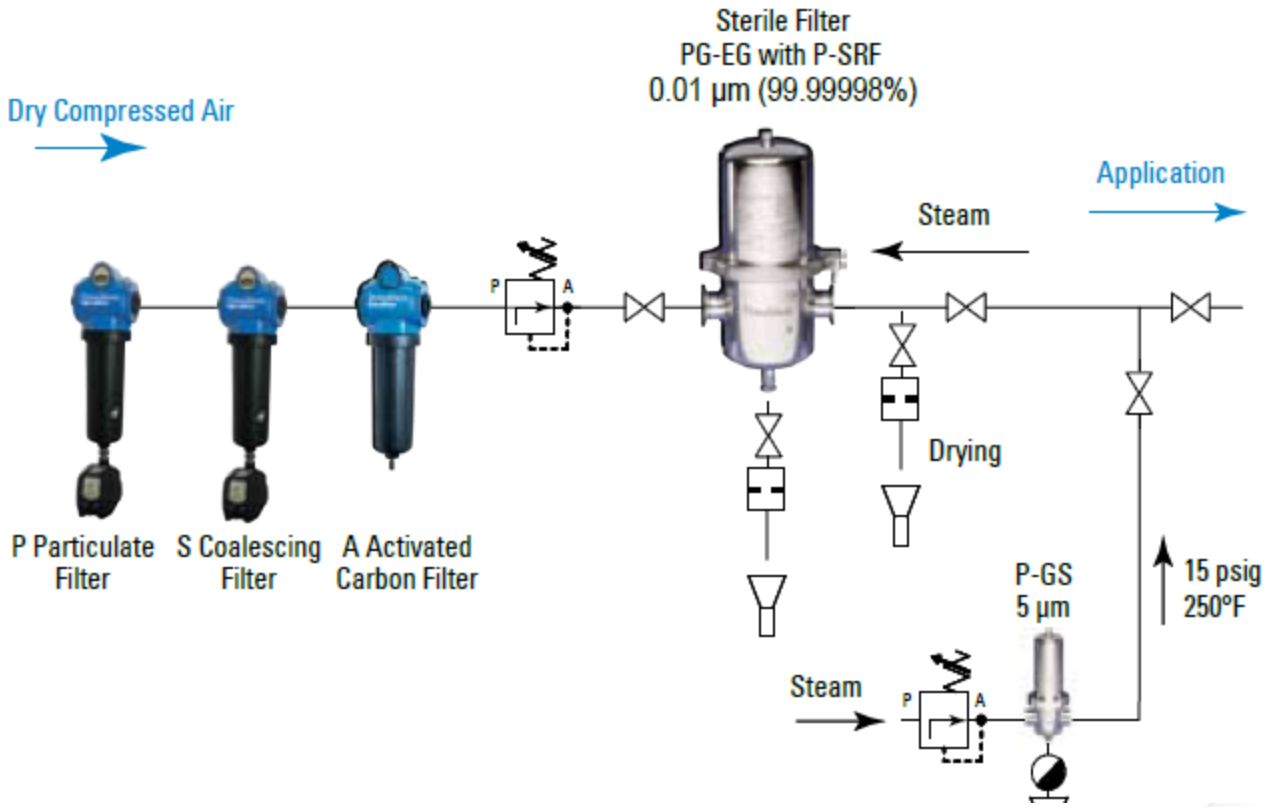
- **Injection:** A large quantity of steam is injected directly into the product under controlled conditions.
- The quality of steam entering the milk must therefore be closely controlled????

Steam Quality Dairy Applications – Aseptic Filling



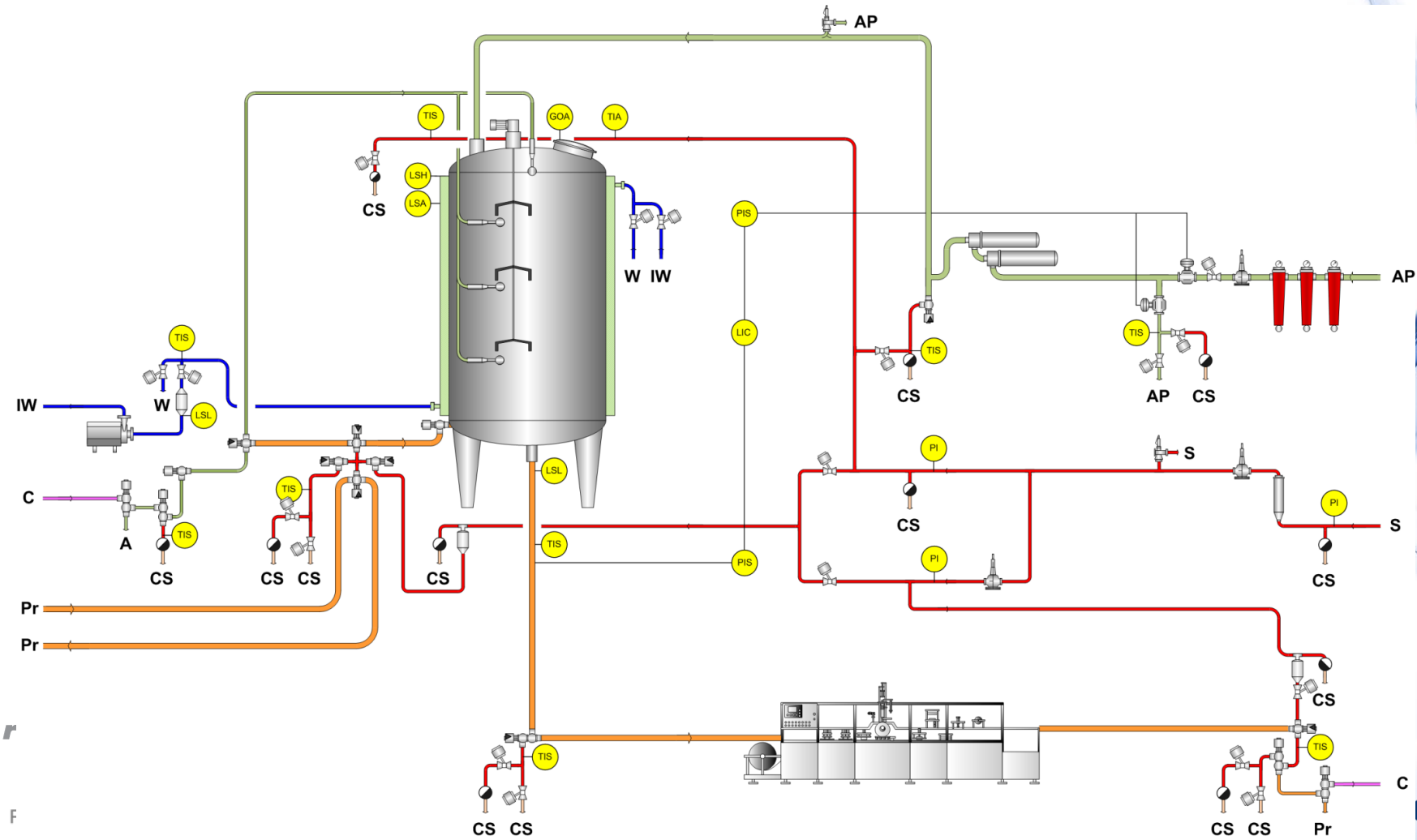
- Manufacturers go to great lengths to ensure the sterility of the product, process line, bottles, etc., to ensure product shelf life is not affected!
- If steam is in direct contact with the process/product, surely we must measure the quality of the steam?

Steam Quality Dairy Applications - Compressed Air Sterilisation

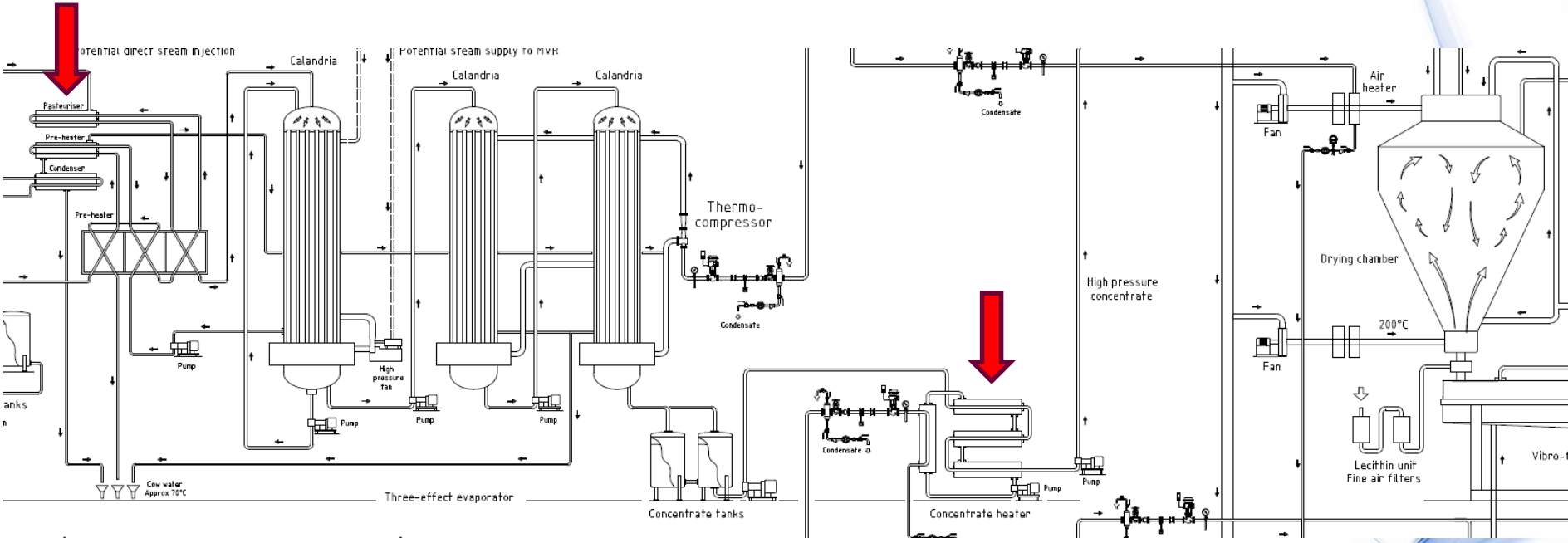


Steam Quality Dairy Applications - Sterilise in Place (SIP)

- Steam is often used to Sterilise in Place (SIP) filling heads and aseptic filling lines



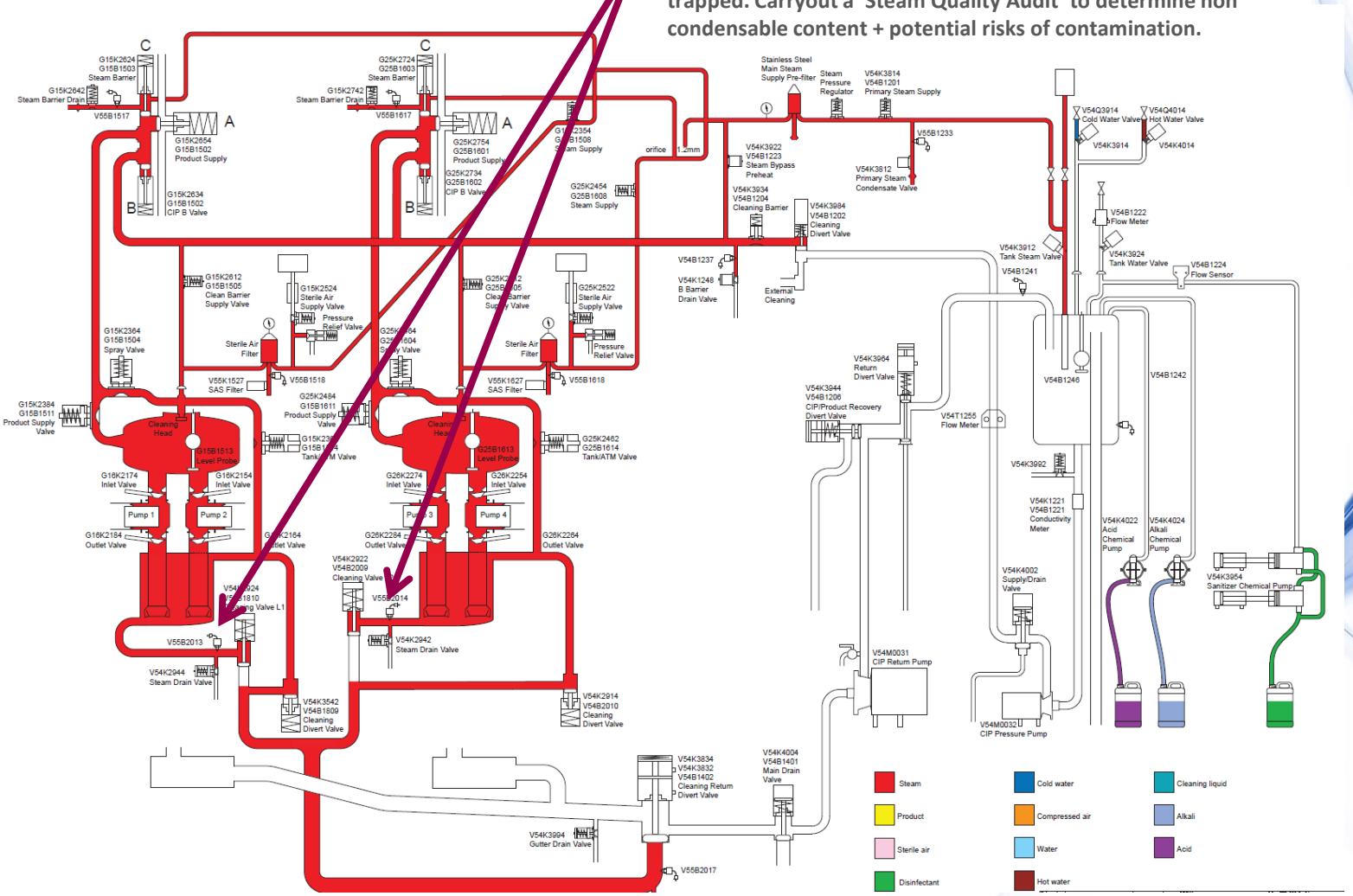
Steam Quality Dairy Applications - Powdered Milk



- Steam can be used directly in contact with the milk during the milk powder pasteurisation process.
- Steam can sometimes be used directly in contact during concentrate preheating.

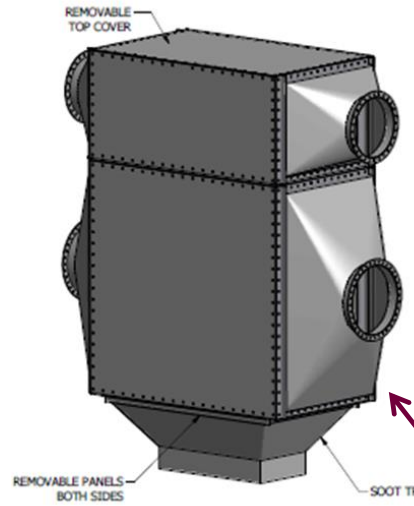
Dairy Filling Head Sterilisation Process – Steam Preheat

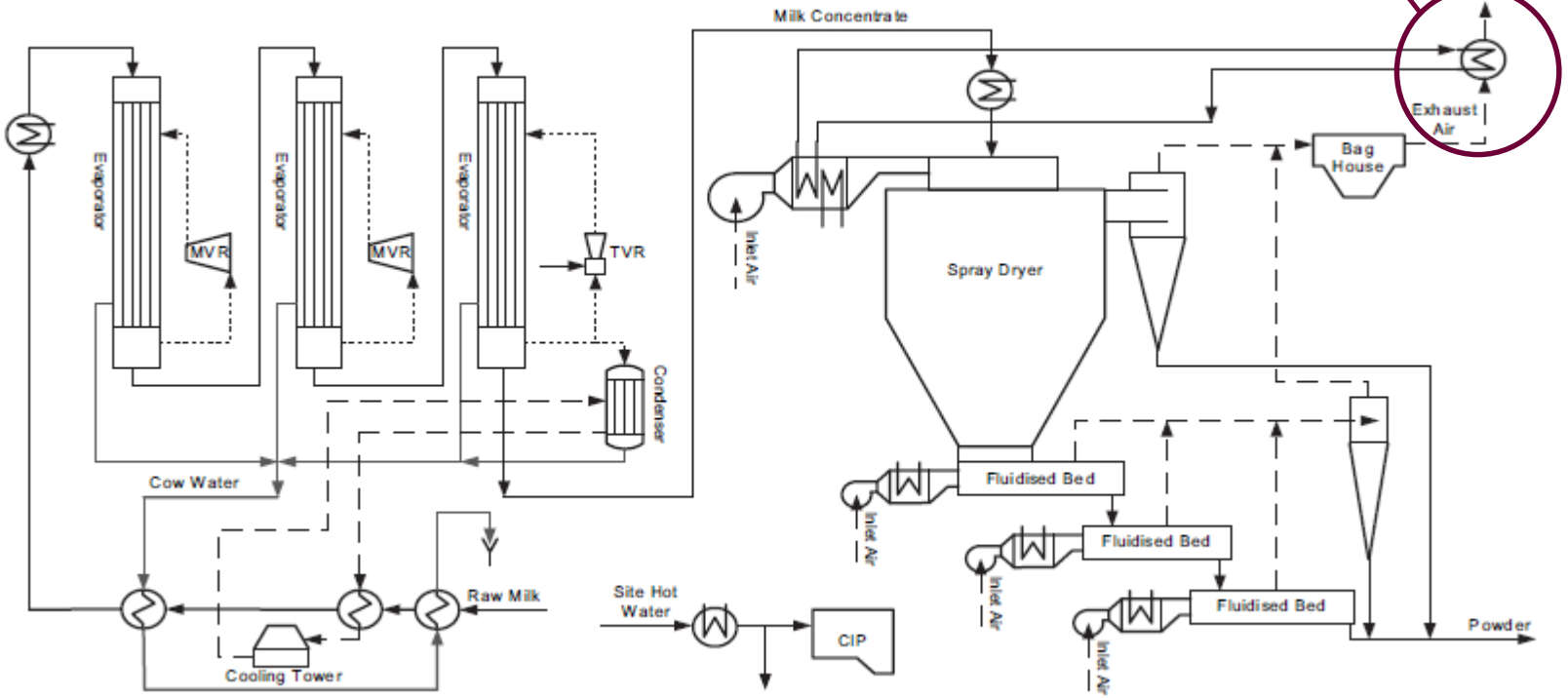
The filling head sterilisation process can experience temperature drop, resulting in the sterilisation being re-started! This drop out 'could' be caused by non condensable gases in the steam line being trapped. Carryout a 'Steam Quality Audit' to determine non condensable content + potential risks of contamination.



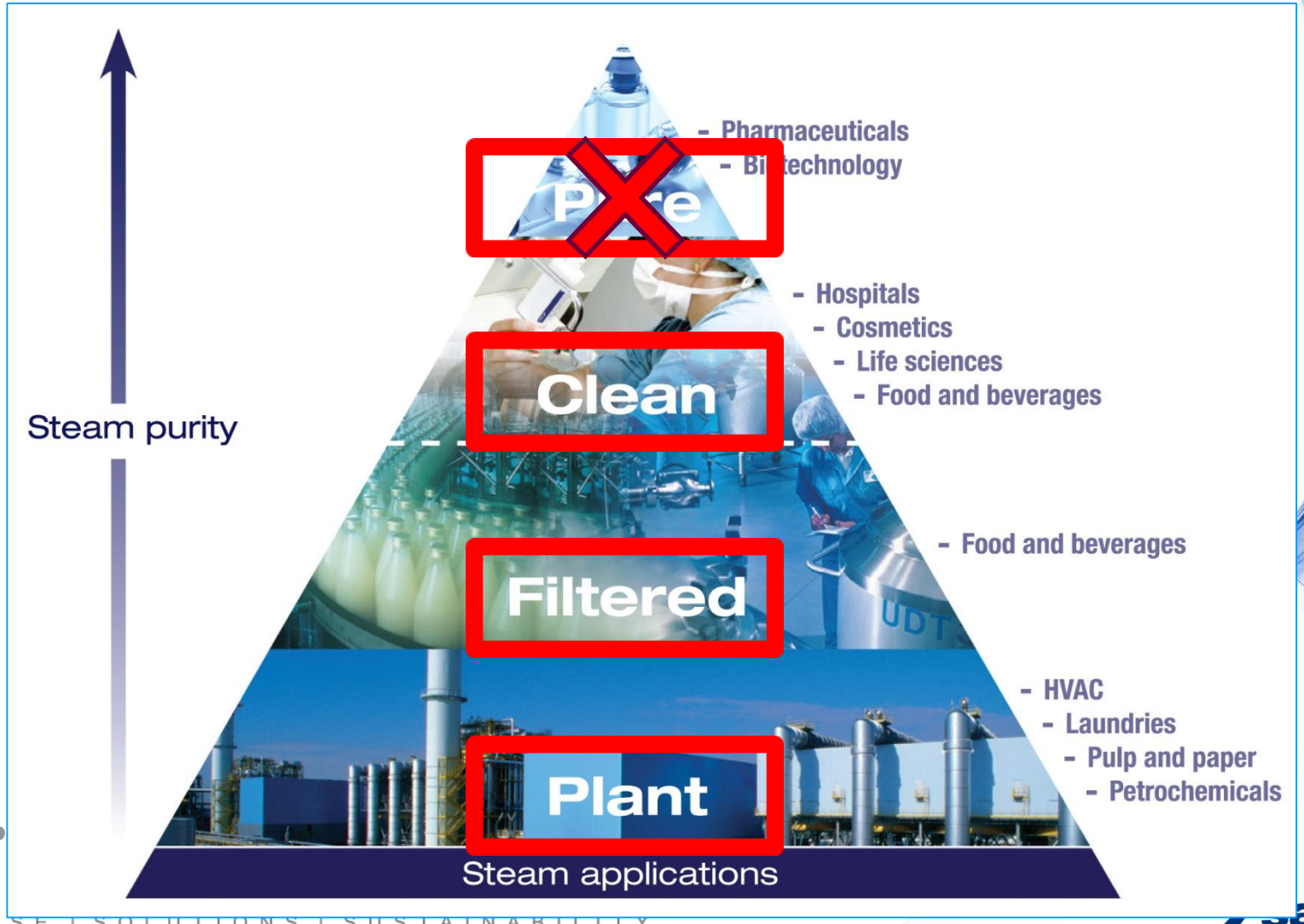
Milk Powder Exhaust Heat Recovery

- Known heat loss opportunity.
- Main issue: High contamination from milk powder.

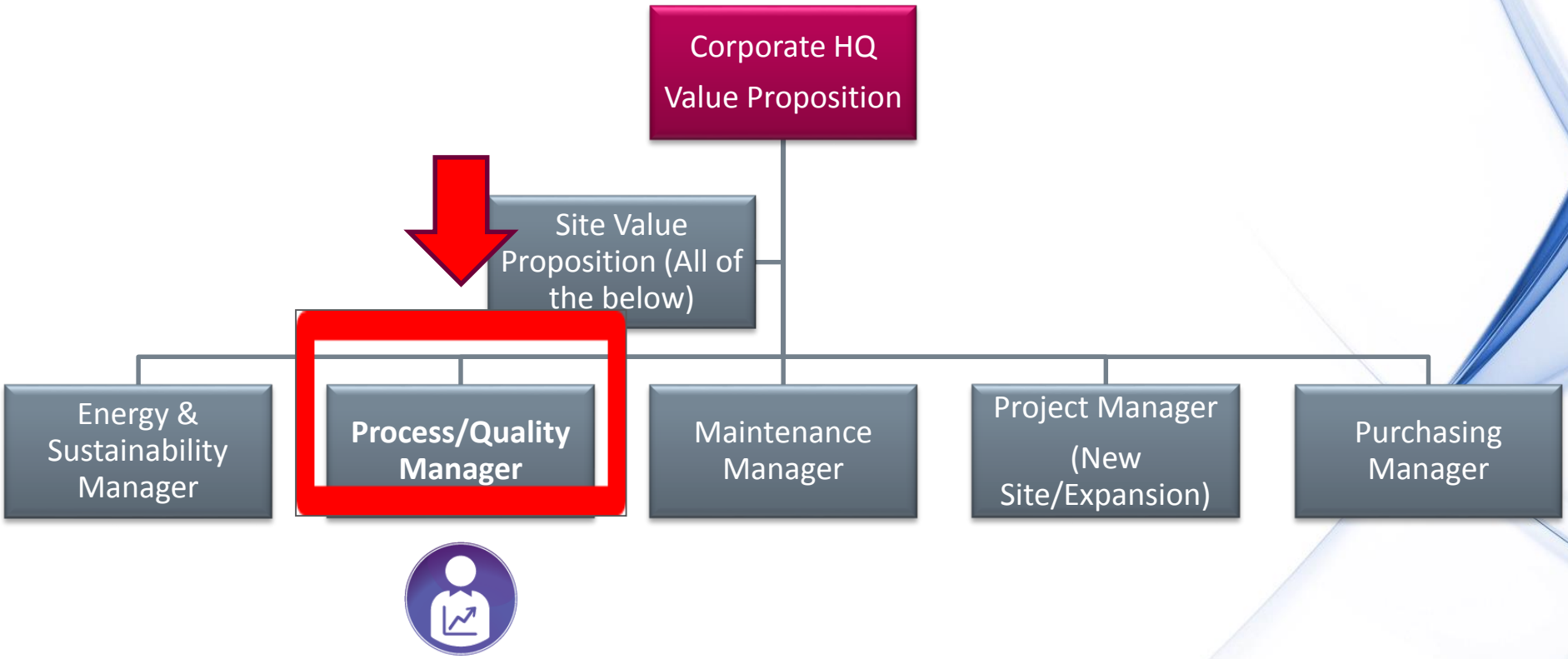




Steam Grade Definitions



Who is Interested in Product Quality & Compliance?



Customer Requirements

How is steam quality relevant to these factors?

- **Product Quality and Brand Value:**
  - Can be affected through steam contamination

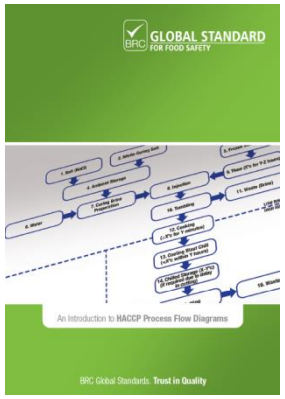
- **Legal Compliance:**
  - ‘Some legislation’ relating to steam quality is in place

Regulations & Standards For Steam In Direct Contact With The Process

First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

Food Safety Guidelines and Legislation



BRC (British Retail Consortium- Global)

ISO 22000 (Food Safety Management System Global)

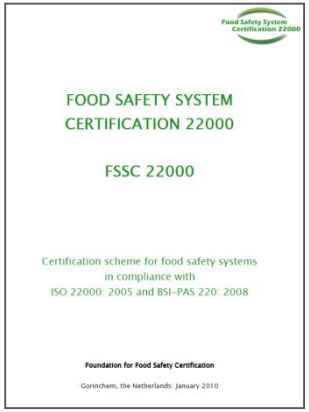

MODEL EXPORT CERTIFICATE
FOR MILK AND MILK PRODUCTS

INTRODUCTION

SCOPE

EXPLANATORY NOTES ON THE MODEL EXPORT CERTIFICATE FOR MILK AND MILK PRODUCTS

CODEX Alimentarius (Global)



FSSC 22000


REGULATION (EC) No 852/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004

on the hygiene of foodstuffs

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

EC 852/2004 (European)

First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

spirax sarco

Guidelines and Legislation – Steam Specific

Main guidelines/standards relating to the quality of steam in contact with the product/process:

USA: FDA: Code of Federal Regulation, Title 21, Volume 3, Section 173.310:

USA 3A- 609-04: Method of Producing Steam of Culinary Quality

Europe: EC No. 852/2004
'Steam used directly in contact with food is not to contain any substance that presents a hazard to health or is likely to **contaminate the food**'

USA: FDA Grade A Pasteurised Milk Ordinance
Boiler feedwater must be of potable water standard

HACCP: International Standard Operating Principle: Hazard Analysis Critical Control Point (HACCP)

Some companies have their own standards e.g. Tetra Pak, Nestlé, etc.

Hazard Analysis Critical Control Point (HACCP)

- Internationally recognised, operating principle
- Do you have a HACCP in place for your process? **(Should have!)**
- Process/Quality Manager will recognise HACCP it is their language!
- Do you have a HACCP Team!
- What has HACCP got to do with STEAM?

HACCP

- The Hazard Analysis and Critical Control Point (HACCP) system is internationally accepted as the system of choice for food safety management!
- It was originally introduced to ensure food safety for astronauts!
- It is a preventative approach to food safety based on **seven** principles.
- HACCP “Team” is likely to be headed up by QA Manager
- HACCP is common language to Process Managers, Quality Managers, etc. and can be used to **DRIVE steam quality!**

HACCP - Example

- Personal Hygiene HACCP - Pre-requisite (site-wide)
- Pest Control HACCP - Pre-requisite (site-wide)
- Cleaning procedure HACCP - Pre-requisite (site wide)

Personal Hygiene:

- Hazard: Potential contamination of process/product

- HACCP procedure
  - Wash hands
  - Gown
  - Hat
  - Over shoes
  - Remove jewellery
  - Beard snood
  - Etc.

Key Stages to Customer Engagement

- Establish where steam is in contact with the process:
  - List applications!
- Identify potential hazards (chemical contamination) for these applications.
- Identify key points of contacts (i.e. QA Manager, Safety Manager.) + who heads up HACCP team)!
- Review the HACCP plan from a steam quality perspective:
  - Should have a **'Process Flow diagram'**
- Process flow diagram should have a 'Process step' for steam injection. **If not it needs to be added as potential source of chemical contamination!**
- By introducing 'steam injection' on HACCP, then identify potential 'hazards and possible causes'.
- Once on the HACCP Report sheet then it has to be addressed

HACCP Report Sheet

Company .....

Date .....

Product .....

Authorised by .....

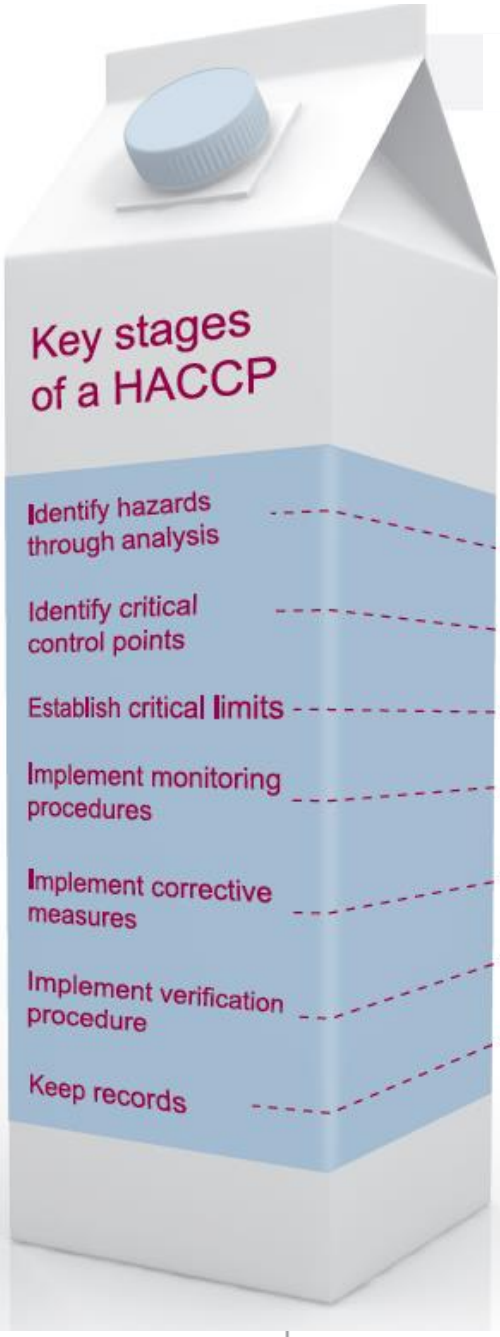
HACCP REPORT SHEET

Scope of study / Terms of reference. Specify product/process/module and which hazards are to be considered

Page ..... of .....

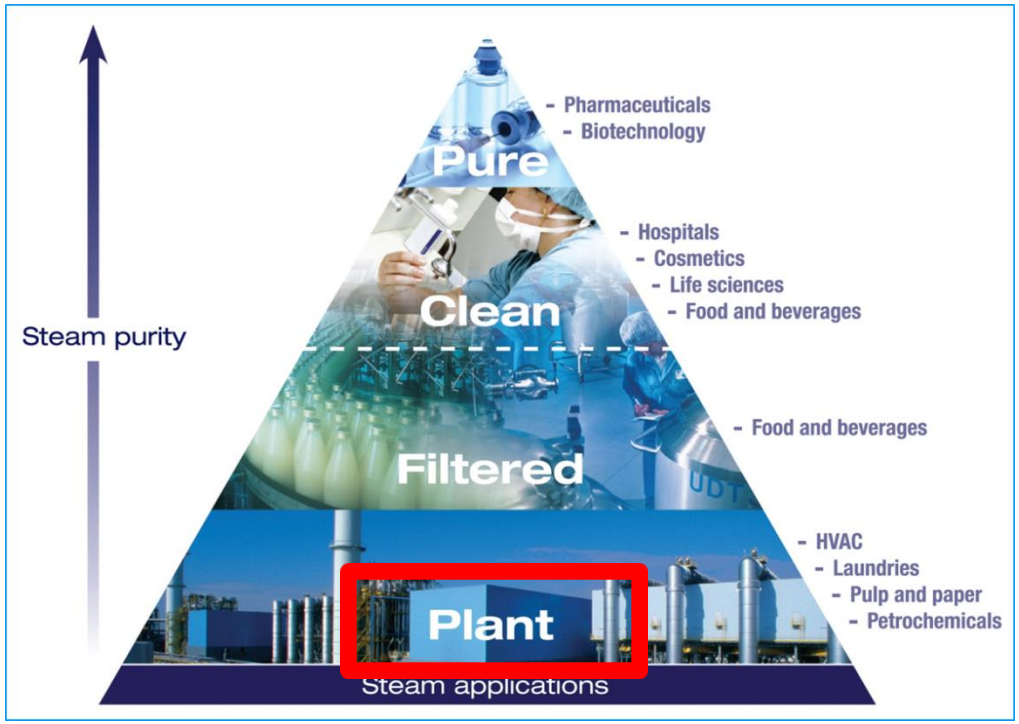
Is it a CRITICAL CONTROL POINT?

No.	Process Step	No	Hazards and Possible Causes	Control Measures	Decision Tree					CCP
					Q1	Q1a	Q2	Q3	Q4	
	• Process step name – as used in flow diagram		• Identify the causes this will assist in specifying the appropriate control measures	• State the appropriate control measures and responsibility If appropriate	Y	-	N	Y	N	CCP
					• Answers from use of the decision tree.					
	• Expand on this to describe where the process starts and finishes, include any key. parameters		• "PIGS" - Presence - Introduction - Growth - Survival	• Include reference details of relevant procedure/work instruction/record forms						
			• Include details of the hazard analysis	• Make reference to prerequisite programme where relevant						



Spirax Sarco Suggests to
get steam quality on the HACCP!

Let's Look at the Hazards

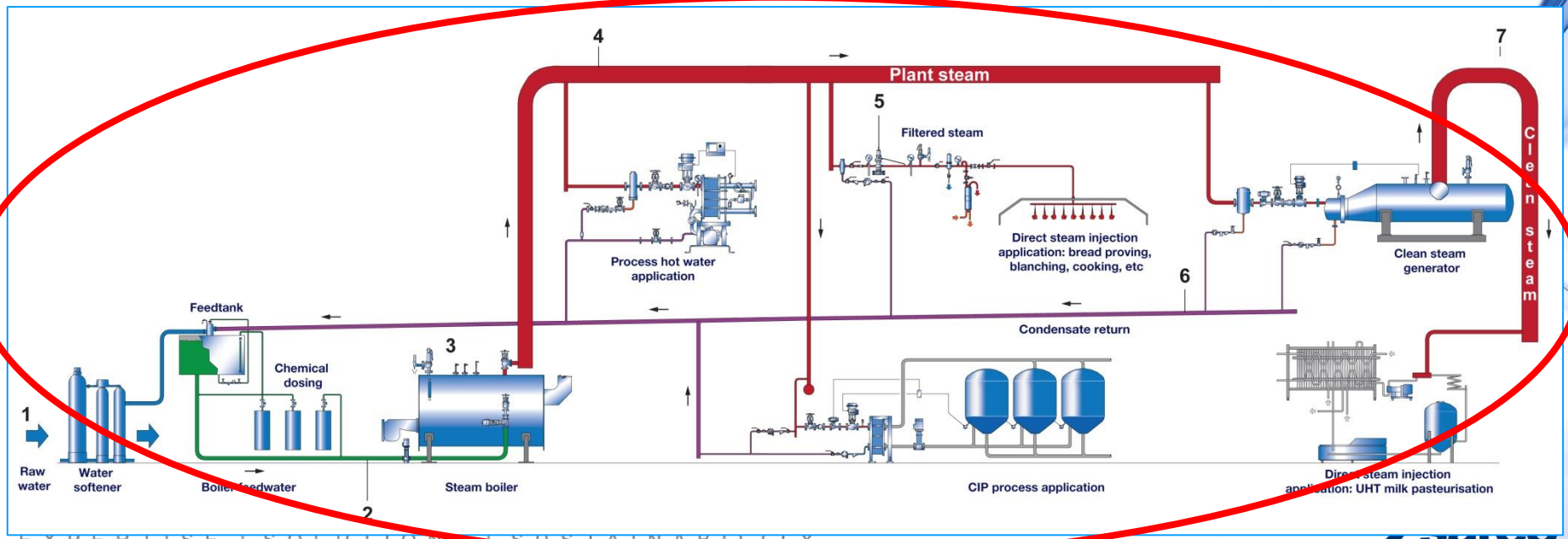


Plant Steam Quality

Plant steam quality is dependant upon many different factors:

- Raw water quality
- Water treatment management
- Boiler loading
- Steam trap management
- Water softening equipment
- Boiler management
- Steam system design
- Cross contamination

Steam Quality is therefore a 'System Approach'



Water Treatment

- Water treatment for boilers must be operated in accordance with a specification to control corrosion, scale, foaming, fouling, etc.In USA they use ASME standards.
- The control of chemical dosage into the boiler should be in line with a boiler water treatment programme e.g. IS- 10392/10496.
- Correct installation/maintenance of water treatment plant
- Parameters controlled, include:

Test	Units	Parameters
pH		10.5 - 12.0
Caustic Alkalinity (OH)	mg/kg as $CaCO_3$	350ppm minimum
Total Alkalinity (M)	mg/kg as $CaCO_3$	1000ppm maximum
Sulphite Reserve	mg/kg as Na_2SO_3	30 – 70ppm
Total Dissolved Solidsmg/kg		3500ppm maximum
Silica	mg/kg as SiO_2	150ppm max
Phosphate	mg/kg as PO_4	30-60ppm
Suspended Solids		Light

Water treatment

- **Food approved chemicals** must always be used when any factory is using steam in contact with the process or product !

Chemical	Purpose
Sodium hexametaphosphate	Antiscalant and sludge conditioner
Sodium hydroxide	Corrosion inhibitor
Sodium metabisulfite	Oxygen scavenger
Sodium metasilicate	Sludge dispersant
Sodium phosphate (mono-, di-, tri-)	Antiscalant and sludge conditioner
Sodium polyacrylate	Sludge dispersant
Sodium polymethacrylate	Sludge dispersant
NN-diethylhydroxylamine	Condensate corrosion inhibition
Tannin powder	Oxygen scavenger
Sulphonated copolymer	Sludge dispersant
PBTC	Sludge dispersant
Methylene phosphoric acid	Sludge dispersant
Diphosphoric acid	Sludge conditioner
NTA (4Na)	Sludge dispersant
Cobalt sulphate	Oxygen scavenger catalyst
Cyclohexylamine	Condensate corrosion inhibition
Morpholine	Condensate corrosion inhibition
Diethylaminoethanol	Condensate corrosion inhibition

These chemicals are usually supplied under proprietary names. Detailed information on the chemical make-up can usually be found on the Safety Data Sheets (SDS).

Guidelines and legislation

USA: FDA: Code of Federal Regulation, Title 21, Volume 3, Section 173.310:

(Food approved) 'Boiler water additives may be safely used in the preparation of **steam** that will contact food, under the following conditions:

(a) The amount of additive is not in excess of that required for its functional purpose, and the amount of **steam** in contact with food does not exceed that required to produce the intended effect in or on the food…….'

Pasteurised Milk Ordinance – Page 238 (FDA)

It should be noted that tannin, which is also frequently added to boiler water to facilitate sludge removal during boiler blow-down, has been reported to give rise to odor problems, and should be used with caution.

Boiler compounds containing cyclohexylmine, morpholine, octadecylamine, diethylamino-ethanol, trisodium nitrilotriacetae, and hydrazine shall not be permitted for use in steam in contact with milk and milk products.

BOILER OPERATION

A supply of clean, dry saturated steam is necessary for proper equipment operation. Boilers and steam generation equipment shall be operated in such a manner as to prevent foaming, priming, carryover and excessive entrainment of boiler water into the steam. Carryover of boiler water additives can result in the production of milk or milk product off-flavors. Manufacturers' instructions regarding recommended water level and blow-down should be consulted and rigorously followed. The blow-down of the boiler should be carefully watched, so that an over-concentration of the boiler water solids and foaming is avoided. It is recommended that periodic analyses be made of condensate samples. Such samples should be taken from the line between the final steam separating equipment and the point of the introduction of steam into the milk or milk product.

Water Treatment

- **Food approved chemicals** must always be used when using steam in contact with the process or product!
- Approval is given by FDA or local equivalent.
- Even though the boiler water treatment chemicals are food approved they should only come in contact with the product/process in a **VAPOUR** form and even then there are FDA limits!

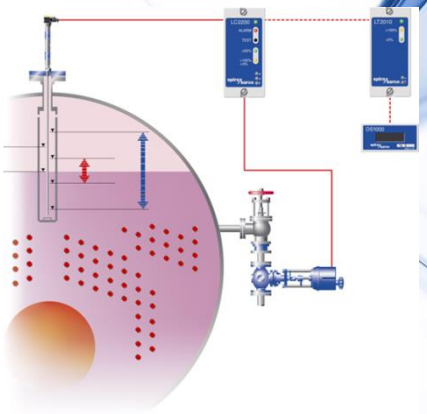
Substances	Limitations
Cyclohexylamine	Not to exceed 10 parts per million in steam, and excluding use of such steam in contact with milk and milk products.
Diethylaminoethanol	Not to exceed 15 parts per million in steam, and excluding use of such steam in contact with milk and milk products.
Hydrazine	Zero in steam.
Morpholine	Not to exceed 10 parts per million in steam, and excluding use of such steam in contact with milk and milk products.
Octadecylamine	Not to exceed 3 parts per million in steam, and excluding use of such steam in contact with milk and milk products.

Potential Contamination from Boiler Chemicals

Boiler Carryover

Priming: The sudden draw off of boiler water into the steam off-take is generally due to one or more of the following:

- Operating the boiler with an excessively high water level.
- Operating the boiler below its design pressure, increasing the volume and the velocity of the steam released from the water surface.
- Sudden, excessive steam demand.

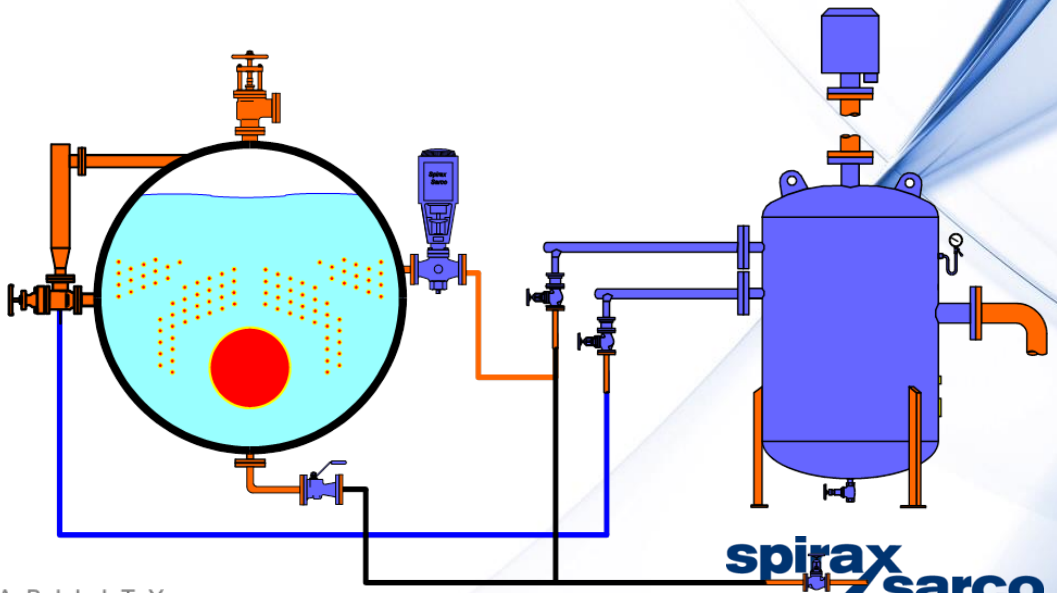


FDA Standard: Controls the chemical limits on **steam**. Priming is **not steam** and will therefore contain very high concentrations of chemicals!

Boiler Carryover

Foaming: This is the formation of foam in the space between the water surface and the steam off-take and is generally due to one or more of the following:

- Incorrect selection, installation, maintenance of raw water pre-treatment plant.
- High levels of Total Dissolved Solids (TDS) in the boiler.
- Excess water treatment chemicals, i.e. non adherence to a water treatment programme.
- High alkalinity (>1 000 ppm).



Scale & Corrosion

- Scale deposits:
  - Build up of calcium carbonate on boiler tubes, steam distribution system, plate heat exchangers, etc.
  - Potential **particle contamination** in process/product.
  - Reduced efficiency.

Scale deposits

- Oxygen corrosion in the steam and condensate pipe.
  - Potential **particle contamination** in process/product.
  - Potential **product failures**, e.g. heat exchangers

Corrective Action – Priming & Foaming

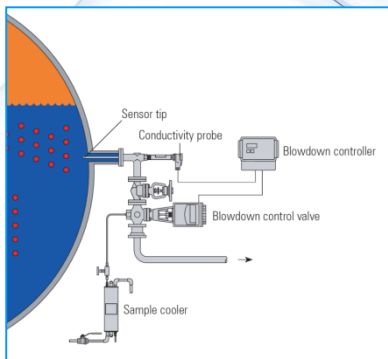
Priming

Boiler Operation:

- Modulating boiler water level controls if on / off boiler controls are currently fitted.
- Operate boiler at the correct ‘design pressure’
- Ensure water level is set correctly
- ‘Surplusing controls’
- Steam accumulator.

Foaming:

- **Water Treatment:**
  - The control of chemical dosage into the boiler should be in line with a boiler water treatment programme e.g. IS- 10392/10496.
  - Correct installation/maintenance of water treatment plant
- **Control of TDS:**
  - Fitting Automatic TDS controls on the boiler will maintain the boiler at optimum TDS levels.



On/off control

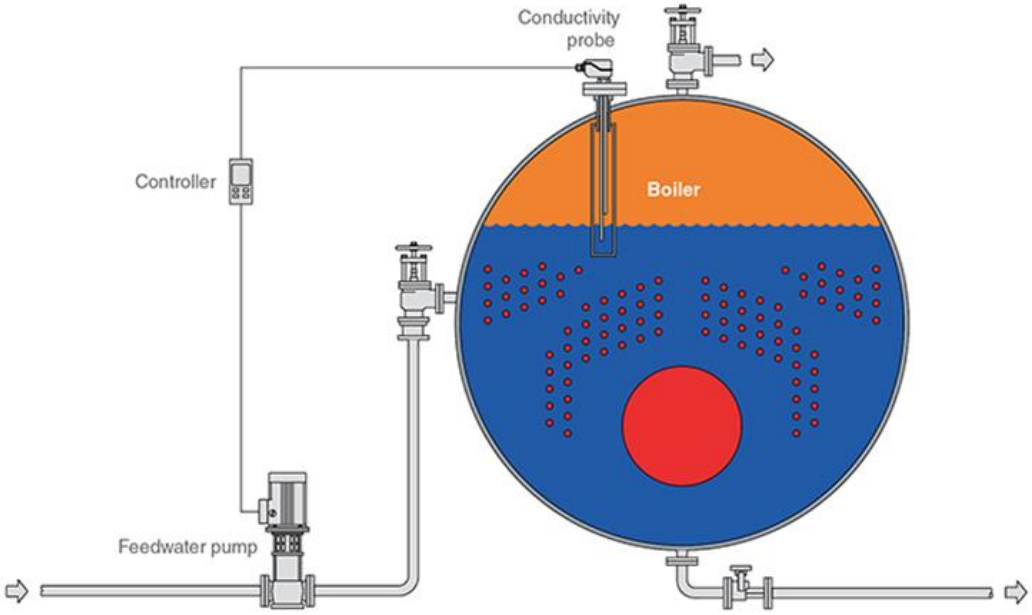
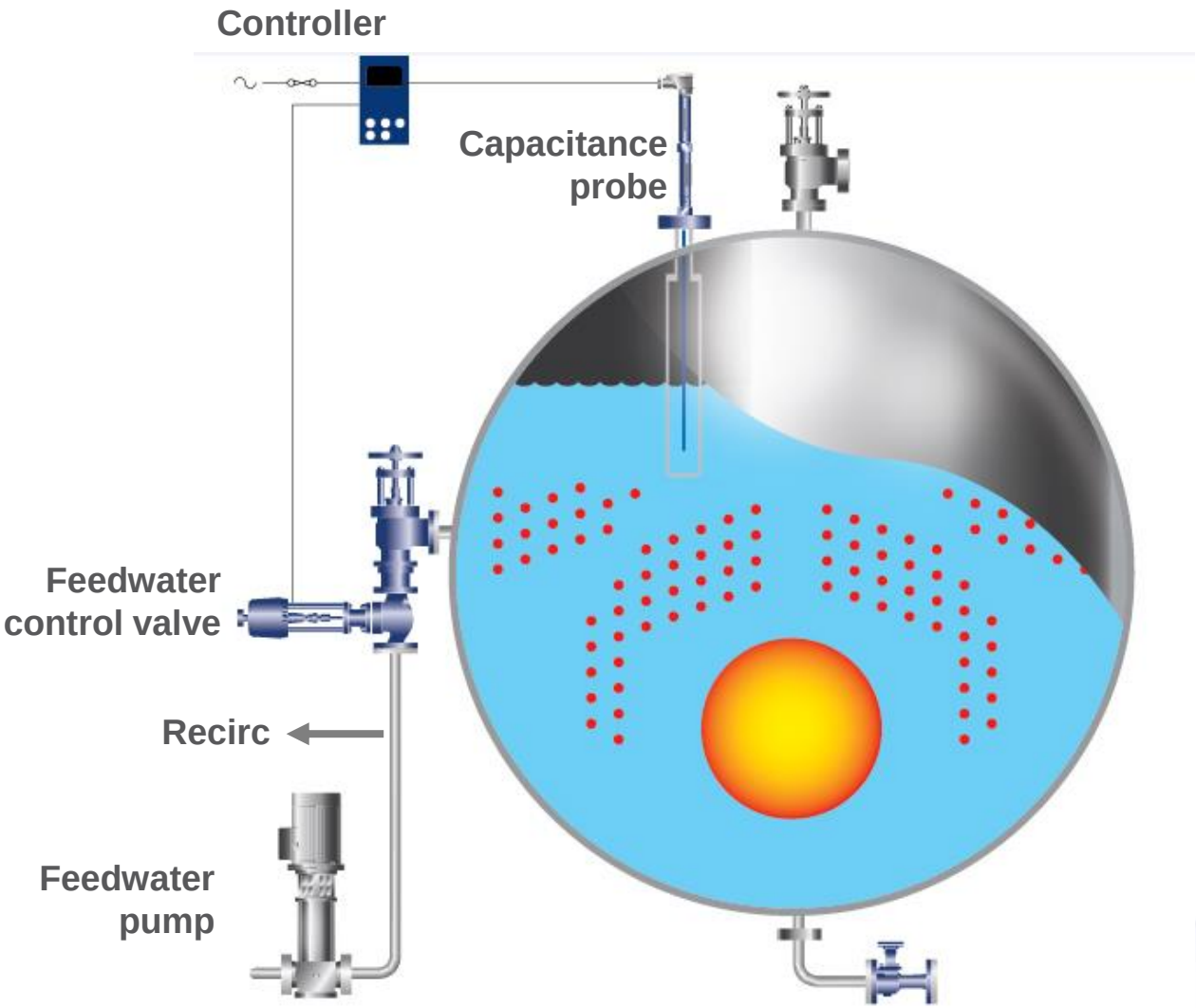


Fig. 3.17.1 On / off control

Modulating Control



Modulating Level Control

Advantages

- Steady steam pressure and flow rate.
- More efficient burner operation.
- Less thermal stress on the boiler shell.
- Less water carry over.
- Can use a central feed pump station.
- Less wear and tear on the feed pump and burner.

Modulating Level Control

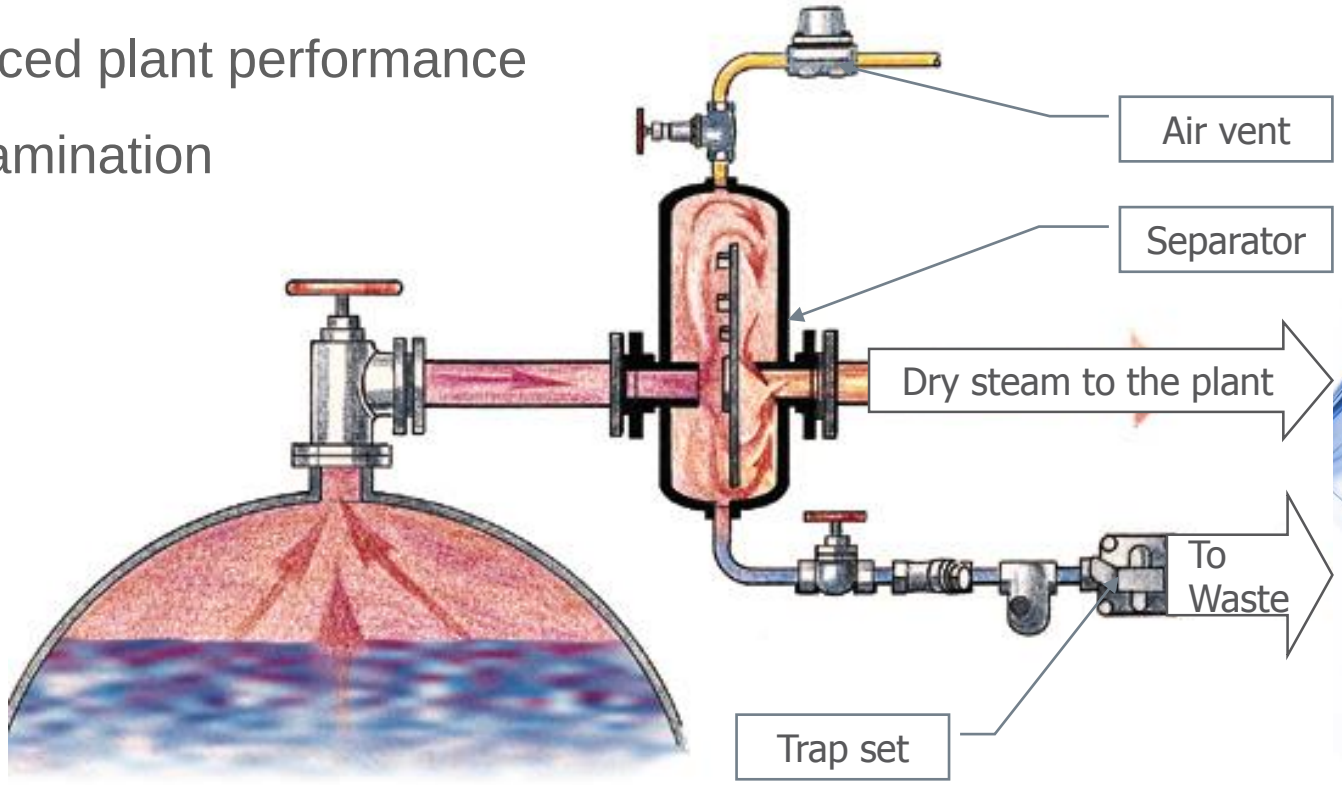
Disadvantages

- More expensive.
- Pump must run continuously.
- Less suitable for ‘stand by’ operation.
- Possibly greater electricity consumption.

Dry steam should be exported to plant

Water in a steam system means:

- Water hammer
- Reduced plant performance
- Contamination



Steam pressure and its Implications

Boilers

- Run boilers at rated pressure

Running at lower pressure

= larger specific volume

= higher surface velocity

= carryover

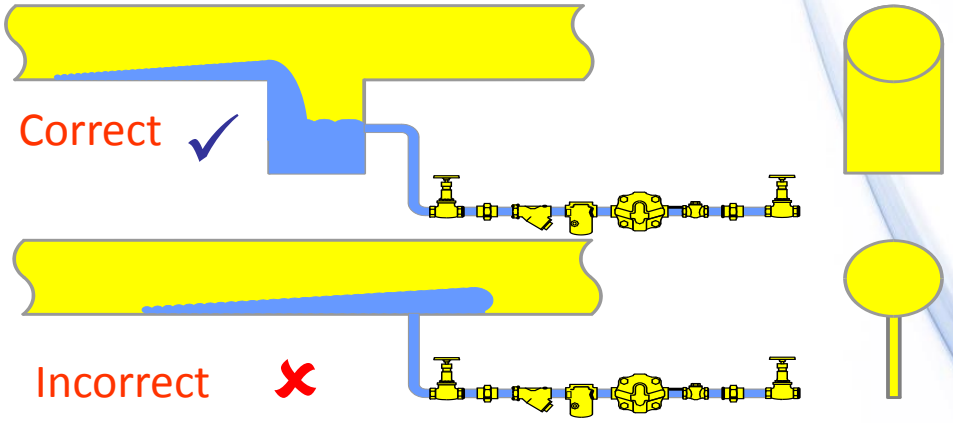
= wet, dirty steam

= Poor Quality

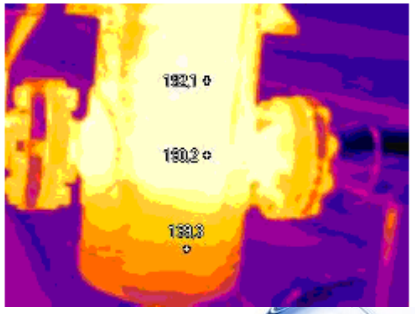
= Lower Productivity & Profits

System Design

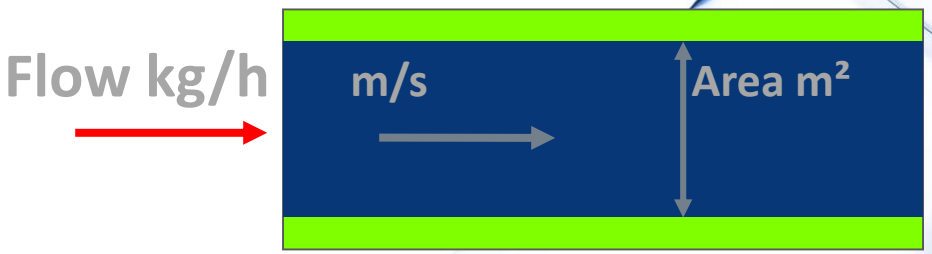
Steam trap installation



Pipe insulation (bear pipe 525W, insulated 80w)



Pipe sizing (velocity)



Cross Contamination

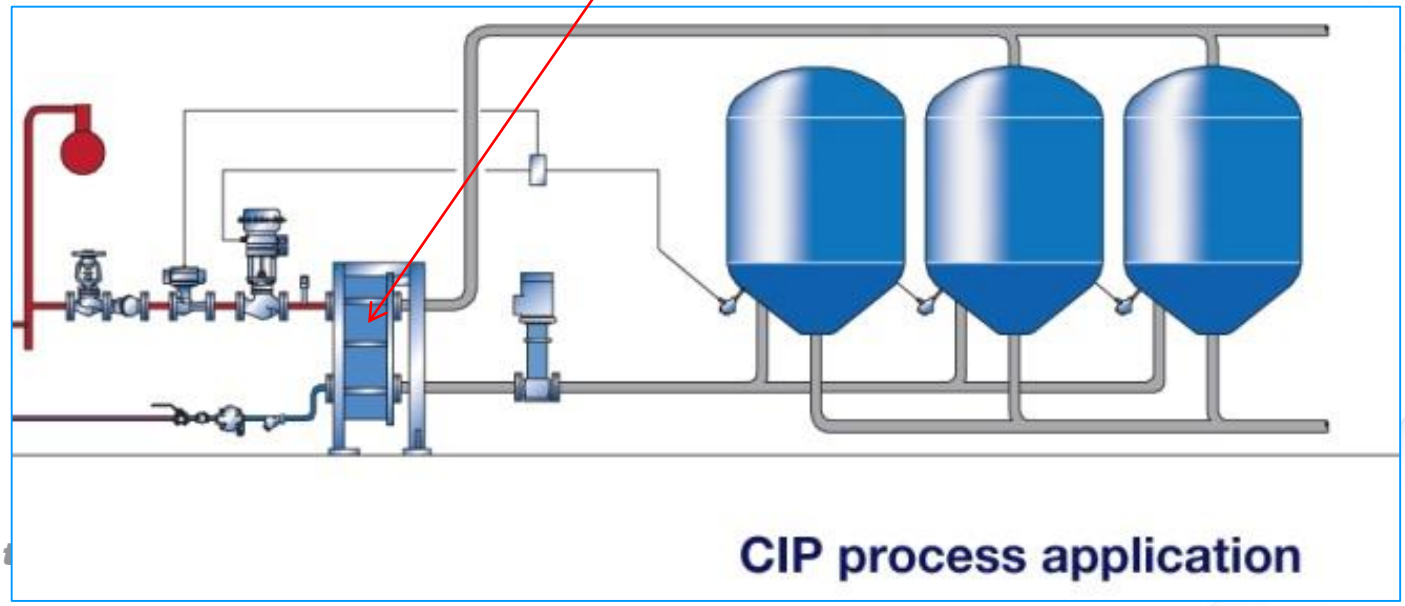
Process **Steam** **CIP**

Cross Contamination - CIP

Most Dairy Industry should return a high % of their condensate. Some may not return condensate due to the risk of cross contamination from:

- Cleaning in place (CIP)
- Process, etc.

Stress corrosion or pin hole failures will cause cross contamination!



CIP process application

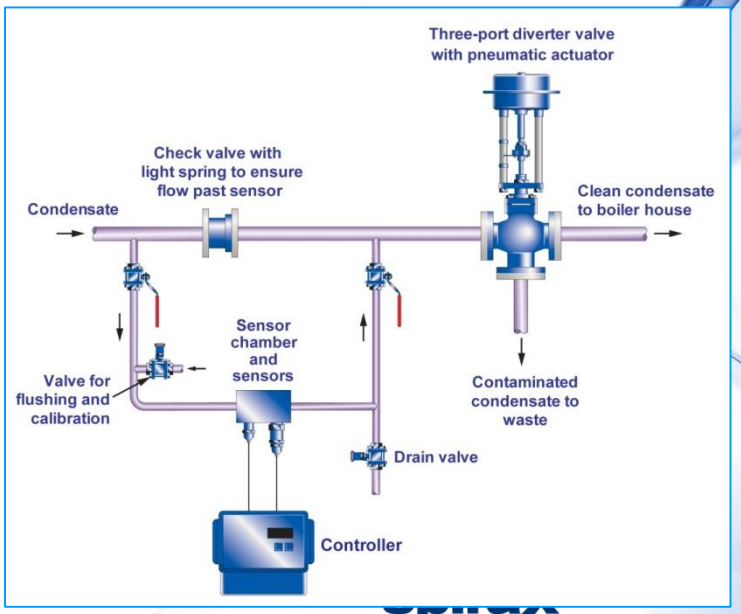
Cross Contamination - Process

- View inside a boiler at orange juice manufacturer
- Process contamination often leads to more foaming and more carryover!

Corrective Action – Cross contamination

- Condensate contamination detection (CCD) systems can be installed to monitor the condensate being returned to the boiler, to prevent contamination.
- **Detecting contamination enables customers to:**
  Save energy/water + prevent process contamination!

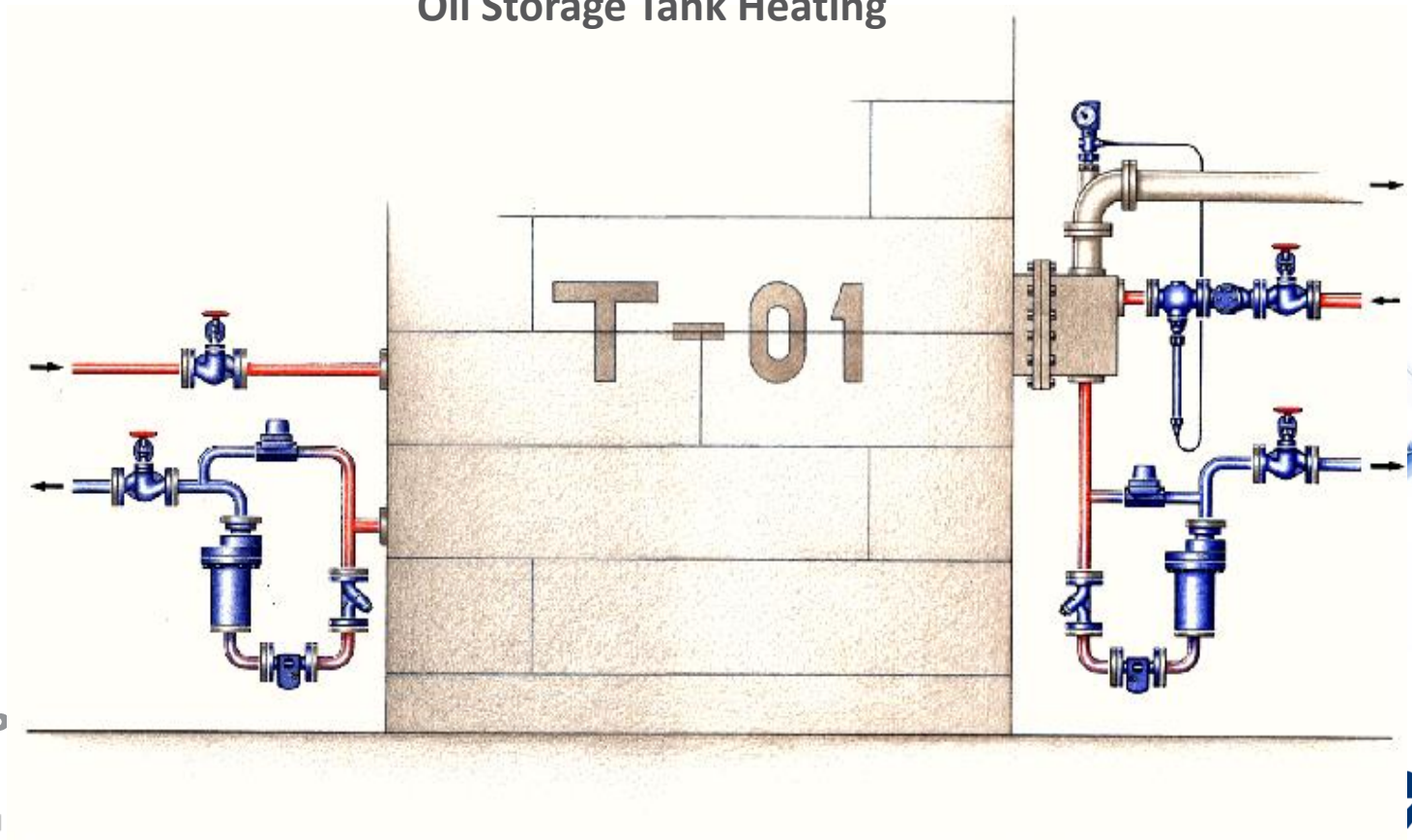
A turbidity meter will detect many contaminants



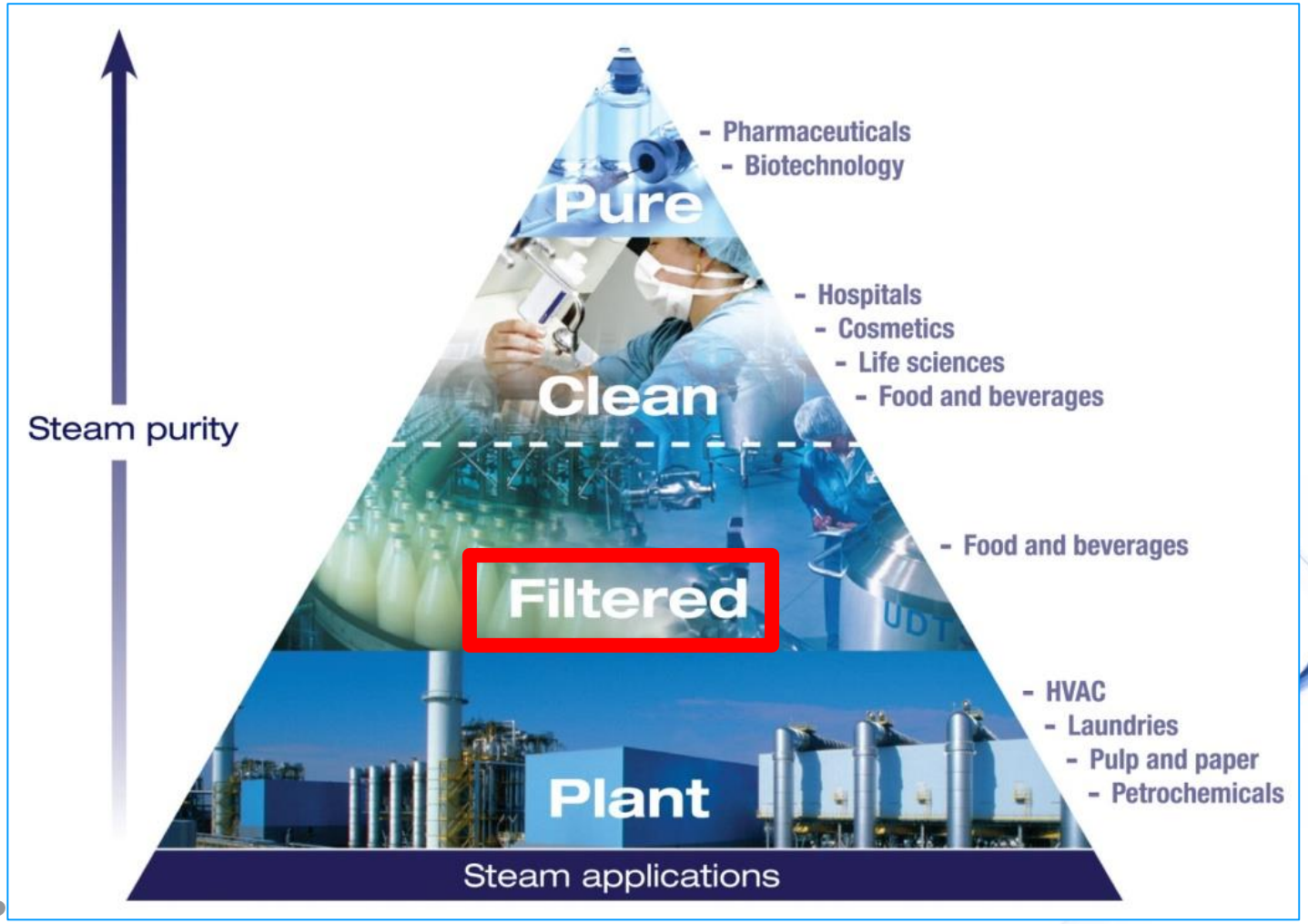
Cross Contamination

- Only return condensate from fuel oil heating systems, if contamination detection is fitted (i.e. turbidity).

Oil Storage Tank Heating



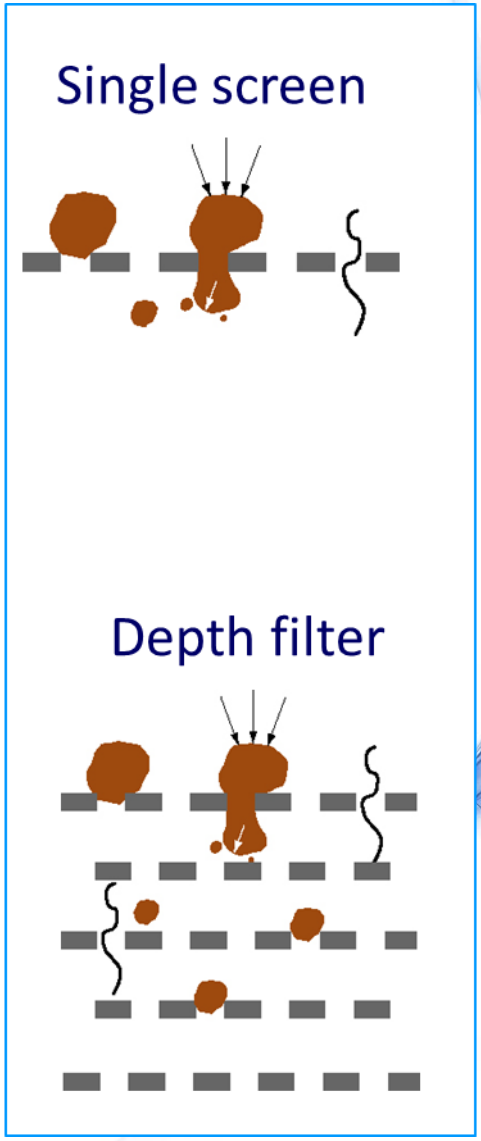
Filtered Steam



How do we produce “Filtered” steam?

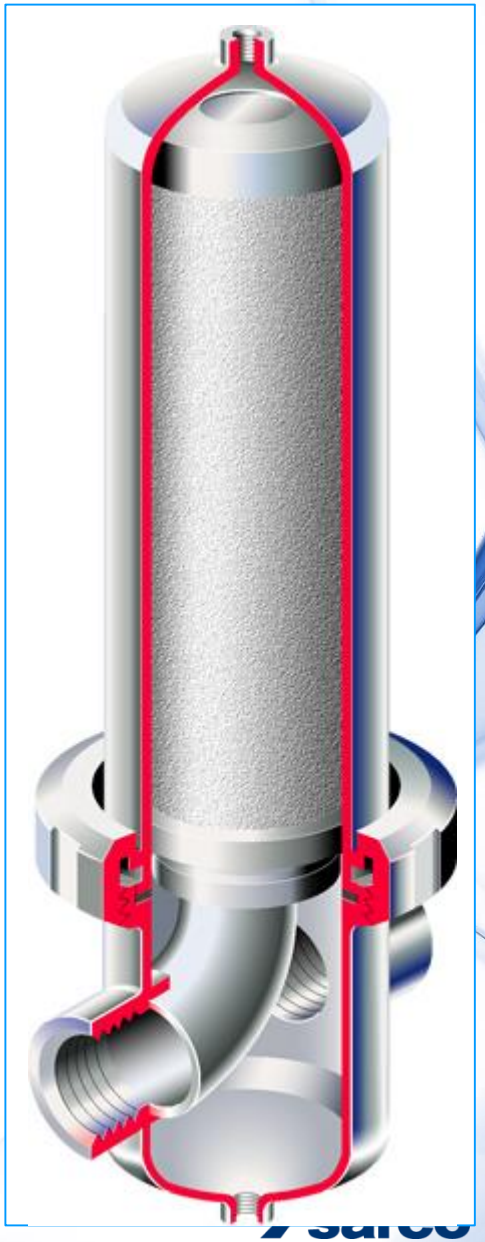
Filtered Steam

- ‘Filtered steam', is plant steam that has passed through a fine stainless steel sintered filter, (typically 5 microns).
- A 5 micron filter element is designed to remove 95% of all **particulates.**
- 3-A Accepted Practices for a Method of Producing Culinary Steam, Number 609 – 4, is a standard developed in the US that establishes the **'minimum'** sanitary (hygienic) requirements for the method of producing culinary steam.
- It is important to note that the section on boiler operation within the 3-A standard, stipulates that boilers should be 'operated in such a manner as to **prevent foaming, priming, carryover**, and excessive entrainment of boiler water into the steam'.



Steam Filters

- Removes particulates only
- Does not effect steam / condensate ‘chemistry’
- **Not designed to remove moisture!**
- **Will quickly block with poor quality steam!**
- 1, 5 or 25 µm element
- Nominal ratings so only removes a percentage of particles: 95-98%
- Sintered elements for finer particles



Filtered Steam – Case Study

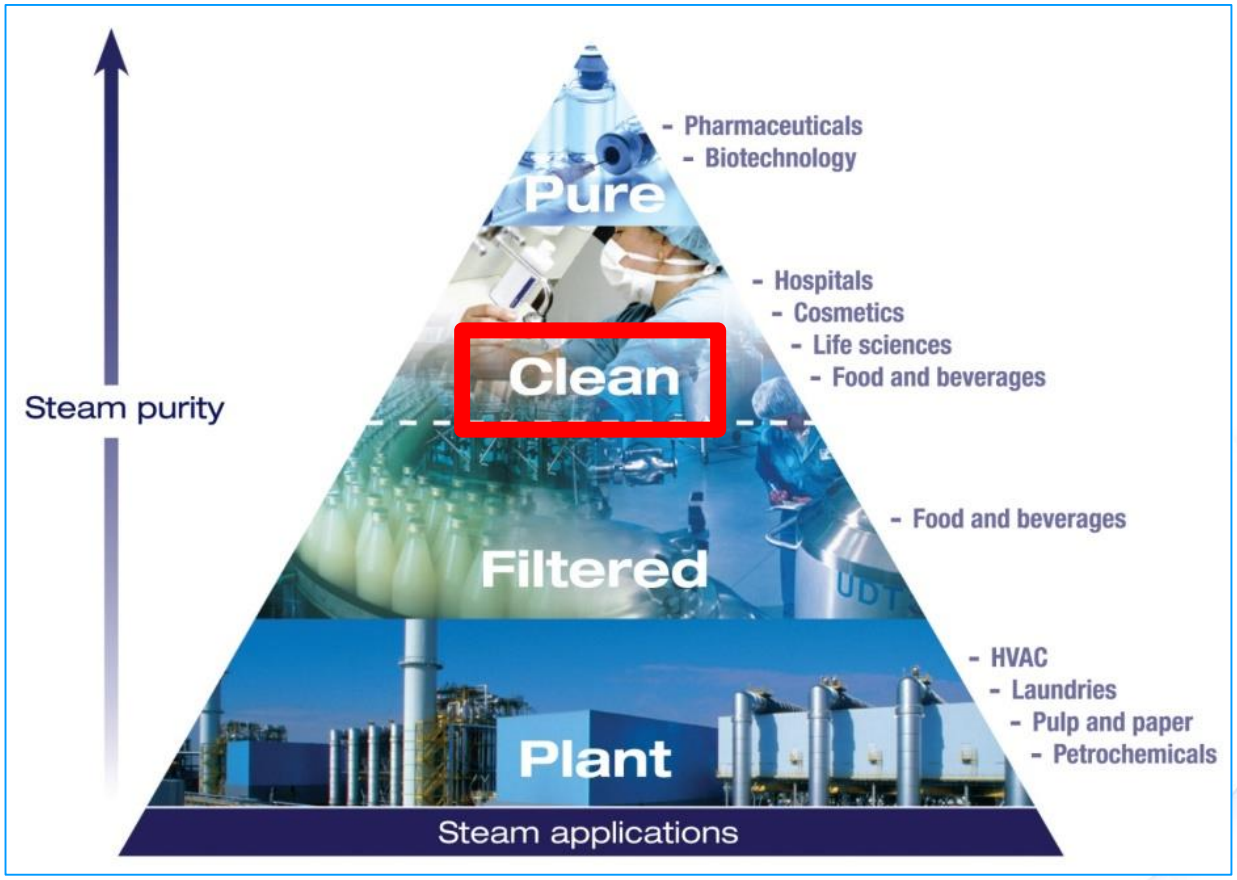
Location: Dairy site Spain

Application: Steam was directly injected into UHT milk

Issue: Customer had no filter installed at all!

Solution: Spirax Sarco CSF16 filter installed. After one month operation the filter was inspected with above results!

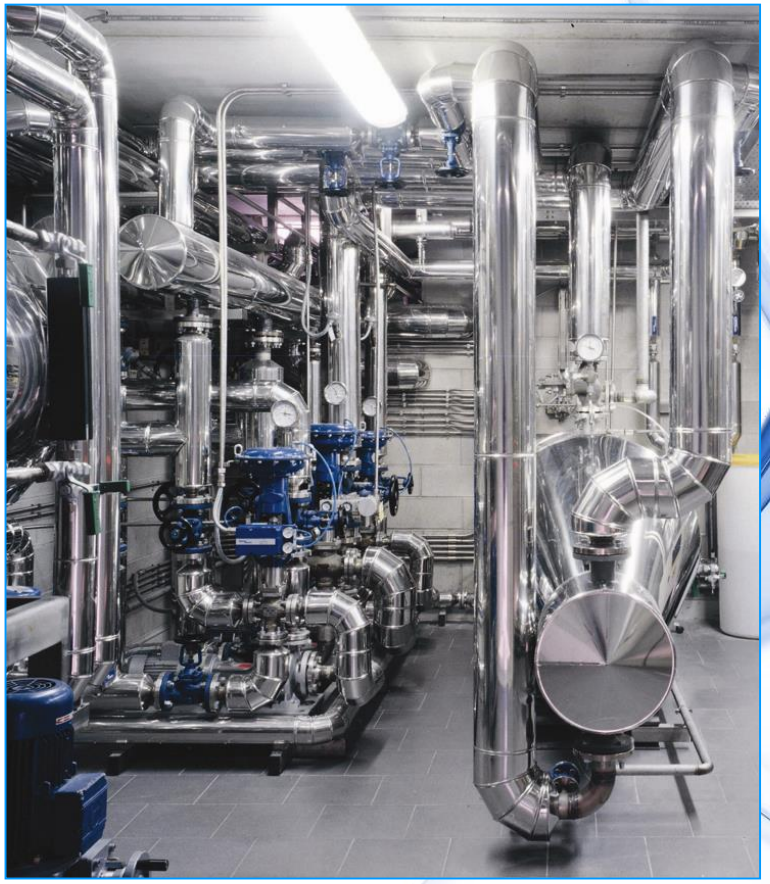
Clean Steam


Steam purity
Pure
- Pharmaceuticals
- Biotechnology
Clean
- Hospitals
- Cosmetics
- Life sciences
- Food and beverages
Filtered
- Food and beverages
Plant
- HVAC
- Laundries
- Pulp and paper
- Petrochemicals
Steam applications

Clean Steam

The potential risk of contamination from particulates, boiler chemicals and cross-contamination **is eliminated** with the use of clean steam, due to:

- Steam being generated in a separate ‘clean steam generator’
- High quality feedwater is used (i.e. RO, DI, etc.)
- No water treatment chemicals.
- Stainless steel downstream pipework and control equipment.



Clean Steam Generation

CSM – K Steam Distribution
Up to 3,800 Kg/hr @ 3 barg

CSM – C Localised Applications
Up to 600 Kg/hr @ 3 barg

STEAM QUALITY AUDIT

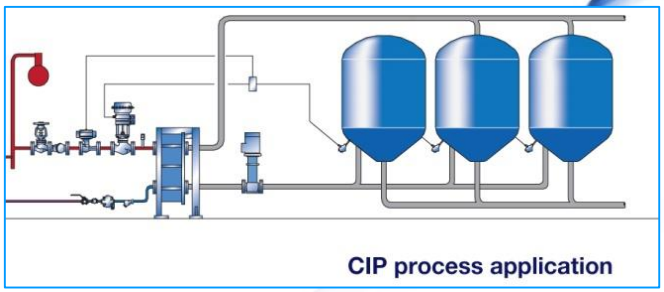
First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

Potential Hazards - Summary

Potential hazards where steam is indirect contact with the process:

- **Particulate Contamination:**
  - **Rust**
  - **Scale**
  - **Particulates**
- **Chemical Contamination:**
  - **Boiler chemicals**
  - **CIP**
  - **Oil**
  - **Process (milk)**



Steam Quality Audit

- Customers MUST comply with **HACCP**, **but very few include steam quality on their HACCP programme!**

- A Steam Quality Audit helps in identifying the potential Hazards, where steam is in contact with the process.

- **No company currently offers an F&B Steam Quality Audit to identify the potential hazards!**

Pasteurised Milk Ordinance – Page 238 (FDA)

U.S. Department of Health and Human Services

Public Health Service

Food and Drug Administration

BOILER OPERATION

A supply of clean, dry saturated steam is necessary for proper equipment operation. Boilers and steam generation equipment shall be operated in such a manner as to prevent foaming, priming, carryover and excessive entrainment of boiler water into the steam. Carryover of boiler water additives can result in the production of milk or milk product off-flavors. Manufacturers' instructions regarding recommended water level and blow-down should be consulted and rigorously followed. The blow-down of the boiler should be carefully watched, so that an over-concentration of the boiler water solids and foaming is avoided. It is recommended that periodic analyses be made of condensate samples. Such samples should be taken from the line between the final steam separating equipment and the point of the introduction of steam into the milk or milk product.

Steam Quality Audit

- **How can we check the quality of steam entering the process?**
  - **Organoleptic Examination (visual):** Appearance (clear, no visible contaminants), odour, etc. Could show the presence of a wide number of undesirable elements.
  - **Conductivity Examination:** Shows the presence of TDS, (normal is 50 – 70 µS.cm)
  - **PH Test:** Typically 6-7, if higher then carryover/contamination could be present).
  - **Dryness Test:** Check for carryover and presence of wet steam .
  - **Chemical Test:** Condense a sample of the steam and analyse the chemical content compared to **local potable water standard**
  - **System Check:** Check the complete steam and condensate installation system for correct design, installation and maintenance (walk the plant). List of 40 check points.
- **Steam System Audit: SxS can provide the expertise to identify the hazards.**

Dryness Testing

Steam quality test equipment, can check for dryness, superheat and non condensable gases.

Existing - Manual Throttling Calorimeter

Spirax Sarco Inline Steam Monitoring System

- **Measures:**
  - NCG Flow-rate
  - Condensate Flow-rate
  - Condensate/NCG Pressure
  - NCG Temperature
  - Condensate Temperature
  - Drain Temperature
  - Barometric Pressure
- **Calculates:**
  - % NCG
  - Superheat
- **Displays /Logs/ Communicates:**
  - % NCG
  - Superheat
  - Steam dryness
  - All process variables
  - All event logs

Steam Quality Audit

- 1 day site chargeable audit that delivers the following:
- Once the Process/Quality Manager is in possession of the report, they will need to address the issues to comply with HACCP!
- **Report could identify the priorities, corrective action plan and continuous monitoring that may be required!**

How can we help you establish a HACCP for using steam in dairy applications?

Key stages of a HACCP

- Identify hazards through analysis
- Identify critical control points
- Establish critical limits
- Implement monitoring procedures
- Implement corrective measures
- Implement verification procedure
- Keep records

Solutions from Spirax-Sarco

- Supply of **Steam Quality Audit**
- Supply of boilerhouse equipment:
  - Level controls
  - Surplusing valves
  - TDS control
  - Separators
  - Accumulators
  - Meters
  - Etc.

- Improvement to steam distribution system:
  - Replacement traps
  - Separators
  - Filtered steam components (3A)
  - Condensate contamination detection systems (CCD)

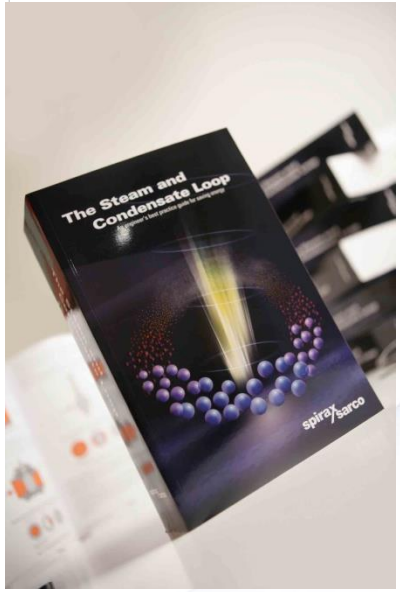
Solutions from Spirax-Sarco

- Supply of Service Agreements:
  - Steam trap surveys
  - Steam quality checking (both dryness + purity compared to potable water standard)

- Potential supply of Clean Steam Generators:
  - SIP
  - Steam in direct contact with the process
  - Sterilisation of air filters
  - Sterilisation of carbon filters

SPIRAX SARCO STEAM TOOLS APP

- Boiler house system,
- steam pipeline system,
- Steam valve sizing,
- Water system App,
- Leakages, orifice, Nozzles.
- Safety Valves
- Cost of steam
- Others



The Steam & Condensate Loop Book- 1464 pages in 117 modules

First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

spirax sarco

THANK YOU

MuthuMurugan
Business Development Manager
muthu.murugan@in.spiraxsarco.com
DDI +91-044-67414816
Mob +91-9444055068

Spirax-Sarco India Pvt Ltd,
Plot No.6, Central Avenue,
Mahindra World City,
Chengalpet Taluk,
Kancheepuram District, 603 004
TamilNadu, India.