RUSSULA

UPGRADE AND OPTIMIZATION OF EXISTING WATER SYSTEMS FOR THE STEEL INDUSTRY

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1. Introduction

- # 3 in world steel production: 88.2 MT/annum (2014)
- More than 100 Steel Facilities
- Quality Seekers and R&D drivers
- **Continuous upgrades Investments…**

Continuous upgrades Investments……in the **Production Line**

- To increase production
- To improve quality and facilitate entry to new markets
- To add value by installing new technology

1. Introduction

Water facilities rarely were impacted by these investments during the last 25 years

- It is **only** an Auxiliary system
- Had less impact on the final product
- Abundance of water resources existed
- Soft environmental restrictions

Most of them operate over their design parameters:

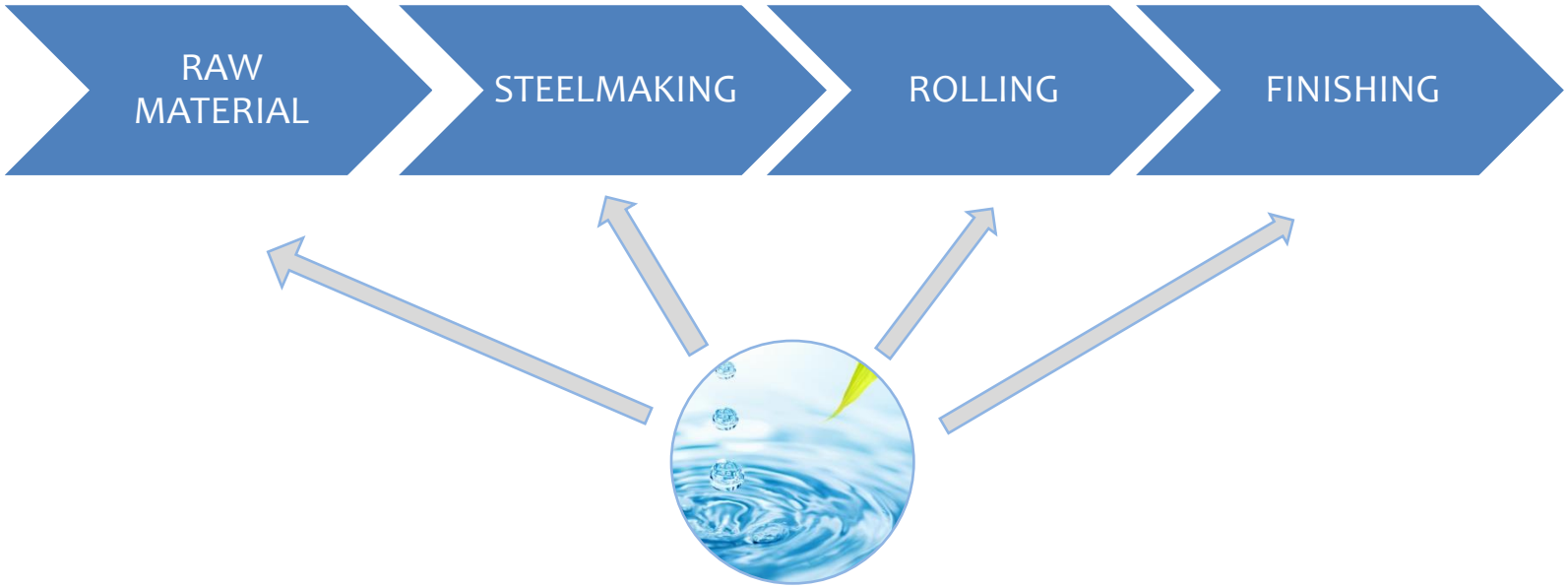
- Poor water quality
- Higher maintenance expenses
- No extra room for production
- Fresh water & Discharges Increased

1. Introduction

Over Capacity
Old Equipment
Low Energy Efficiency
Low Water Recovery
Non-Optimal Water Quality
Effluents discharge

Accurate Design
New Technology
High Energy Efficiency
High Water Recovery
High Water Quality
Effluents recovery

2. Process Value Chain



WATER ADDS VALUE IN EACH STEP OF THE PROCESS

2. Process Value Chain

DEPENDING ON HOW FACILITIES DEAL WITH…

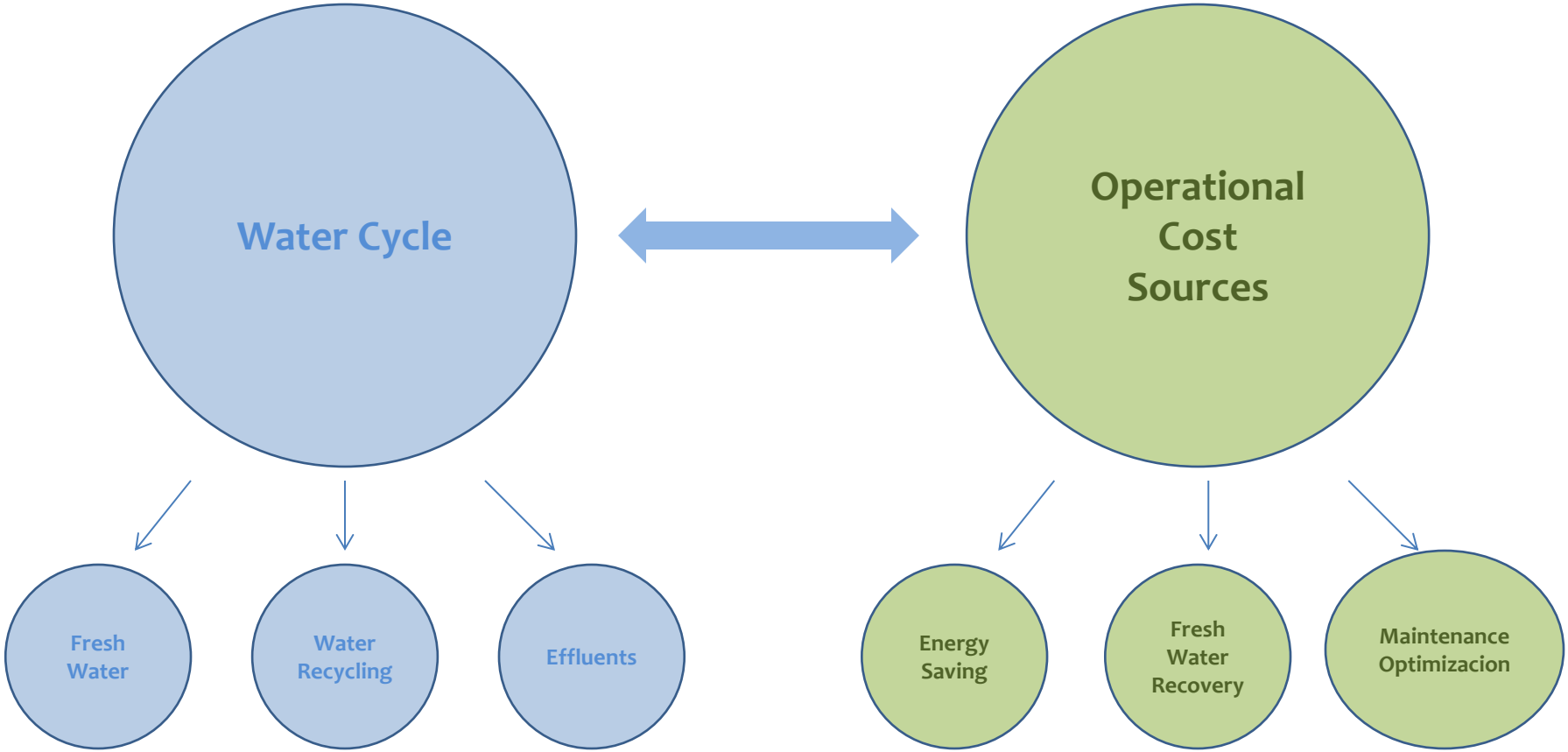
Water Scarcity	Environmental Legislation	Water Recycling Optimization	Operational costs

HIGHER OR LOWER WILL BE THE IMPACT ON THE VALUE CHAIN

COMPETITIVENESS IS THE TARGET

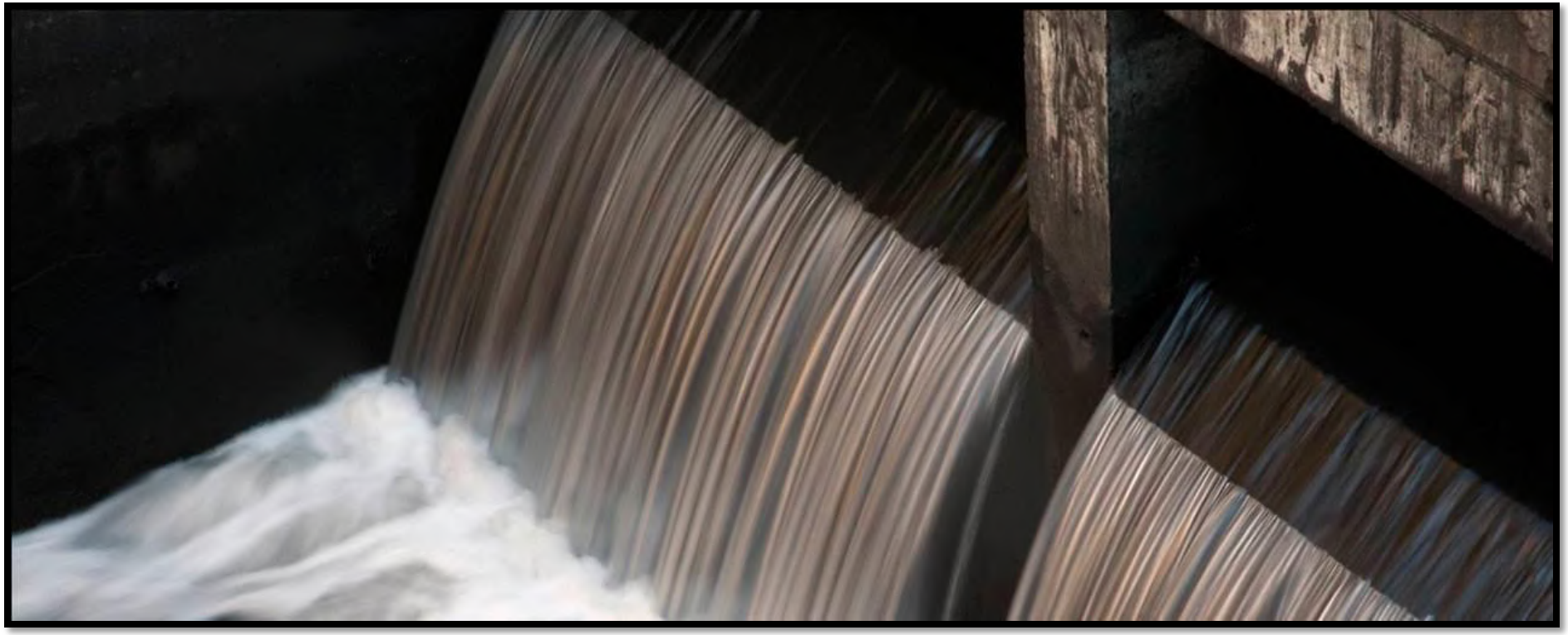
3. Improvement Initiatives

Following the water cycle in a mill, most of the optimization challenge are tackled.



3.1 Water Cycle Approach

WATER PROCESS



3.1.1 Water Cycle Approach – Non Contact

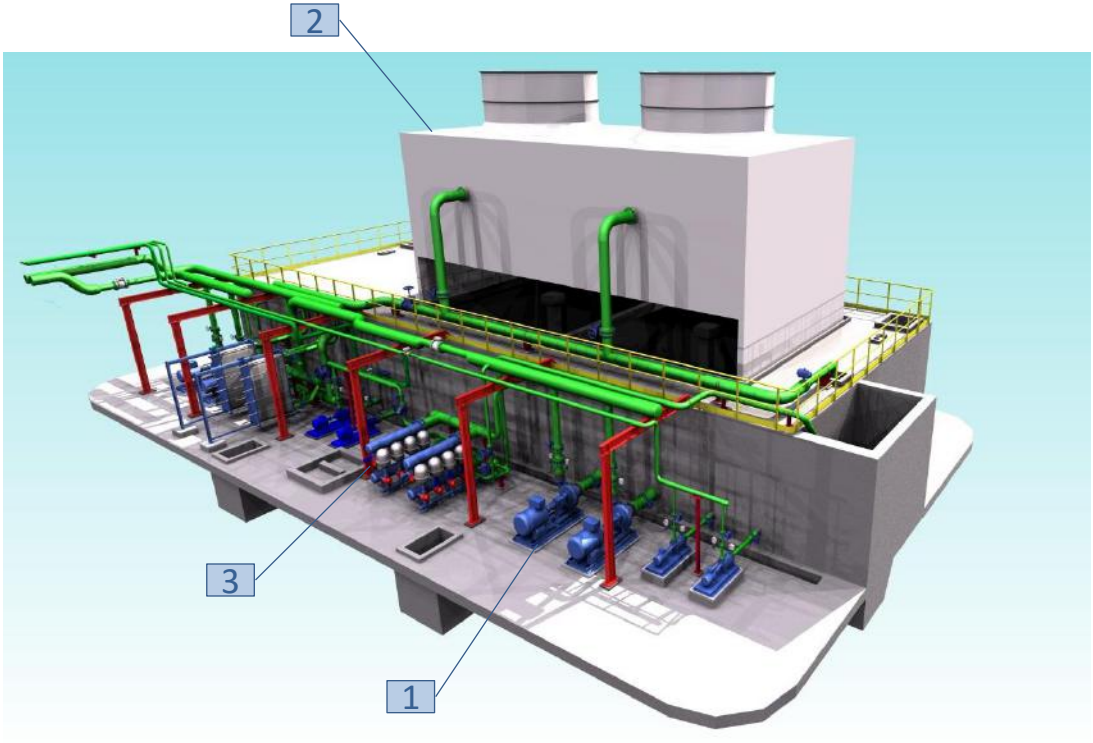
Non Contact Systems

PROCESS: Pumping & Cooling

FLOWS : up to 75000 GPM

TEMPERATURES DROP: 15-20 °F

- Important recirculating flow.
- Big impact in operational cost(energy)
- Big Impact in water needs
- Big Impact in Discharges Effluents



3.1.1 Water Cycle Approach – Non Contact

Energy Saving

Flows Characteristics:

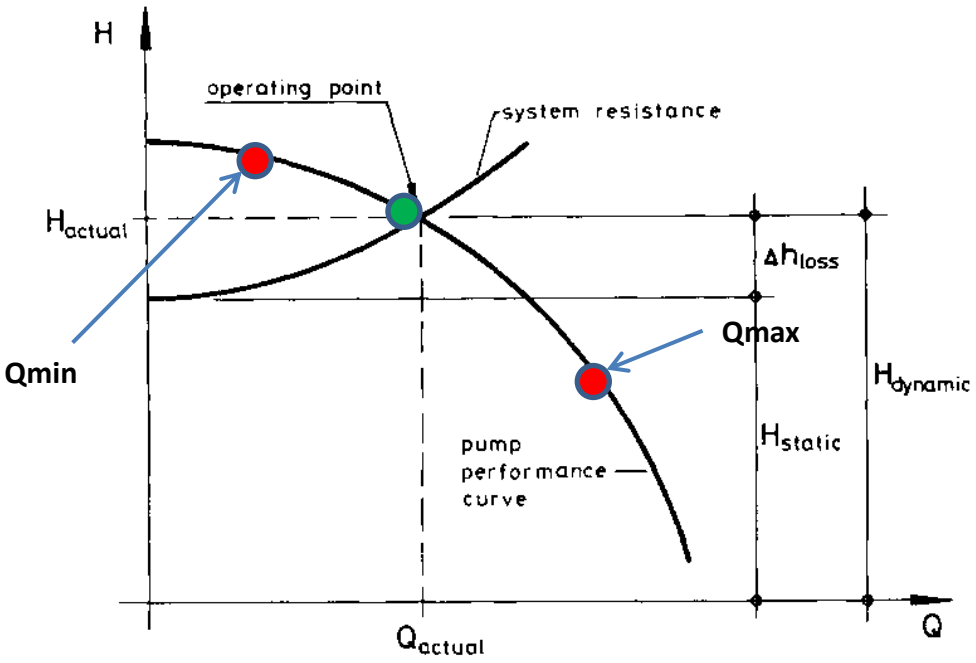
- Steady flow, not many fluctuations
- Several Process, could work independently (IMPORTANT FOR SELECTION)
- Low-medium pressure , except specific process (CCM Molds)

1 Pump System

- Proper Pump selection. Maximum efficiency sought.
    - Right Duty Point (Flow-pressure). Maximum Efficiency
    - Split pump Groups depending simultaneously.
    - Variable Speed Installation (when required). In NCW circuit almost no needed.

3.1.1 Water Cycle Approach – Non Contact

Pump Group Control



Pump Operating Point Range:

- *Qmin:* Before Cavitation
- *Q max:* Due to Pressure Requirements or Motor Limit

Pump Start/ Stop:

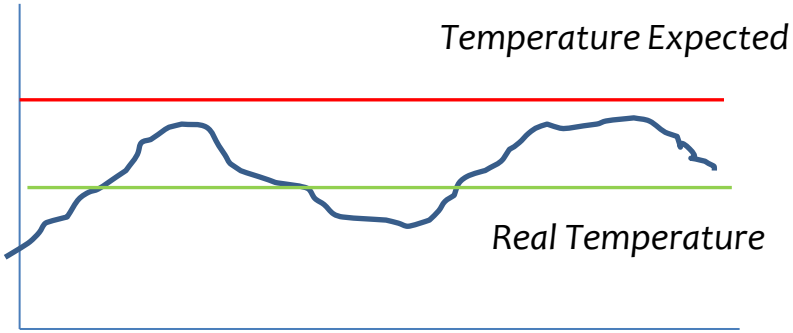
- When : Qt/ N° Pump> Qmax START PUMP
  <Qmin STOP PUMP
- Continuous Flow Measurement: Magnetic Flow Meters
- Could be done with Pressure Transducer, but depends on pump curve. NOT ACCURATE

PUMP SELECTION KEY FOR EFFICIENCY

3.1.1 Water Cycle Approach – Non Contact

2 Cooling Towers

- Equipment selection is key factor.
- Efficiency in splash and laminar films.
- Frequency Converter (Always)
- Efficiency seeking in motor, shaft and blades.
- Check the blade angle



3 Side filtration

- Depending on Filtration Type, energy consumed will change.
- Choose effective and energy saving equipment.
- Example Side Filtration 150 GPM
  - ***Sand Filter Backwash*** :675 GPM

    Backwash time: 20 min
  - ***Ring Filters Backwash*** : 225 GPM

    Backwash time: 8 min

3.1.1 Water Cycle Approach – Non Contact

Water Saving

- Reduce Water need for side filtration
- Proper Cooling Equipment.
- Purges as Fresh Water for Contact Systems

1 Side Filtration

- Average Backwash Flow : 13-15 gpm/ft2
- Backwash duration: minimum 25 minutes
- Seek for substitutes

RING FILTERS (25 microns)

*** Further explanation about technology in following pages*

3.1.1 Water Cycle Approach – Non Contact

2 **Purges Reuse**

Goal ---------- Keep a Concentration cycle of 2.5 - 3

- Reduce amount of Purges
- Water Quality ready to use as make up for Contact systems
- Saving chemicals and fresh water

	Units	CW	NCW
pH:		7 9	7 9
Suspended solids:	mg/l	80	20
Dissolved solids:	mg/l	1500	1000
Max. Particle size:	m(c)	200	200
Chlorides:	mg/l Cl^-	300	300
Sulphates:	mg/l SO_4	200	150
Ca Hardness:	mg/l $CaCO_3$	360	240
Mg Hardness:	mg/l $CaCO_3$	120	80
Total Hardness:	mg/l $CaCO_3$	400	125
Alkalinity:	mg/l $CaCO_3$	300	200
Iron:	mg/l Fe	2	1
Silica:	mg/l SiO_2	75	50
Oil content:	mg/l	10	1

3.1.1 Water Cycle Approach – Non Contact

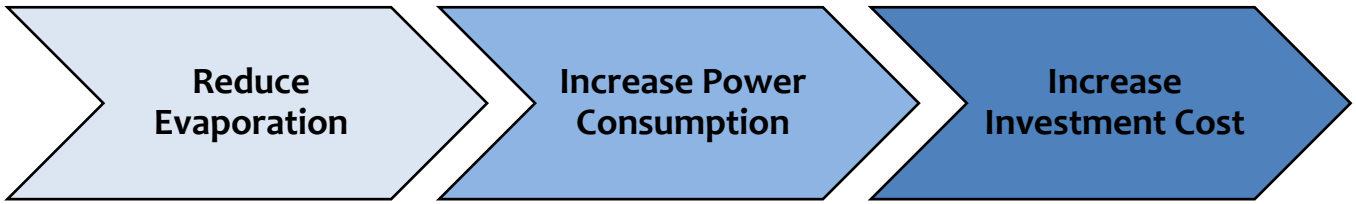
3 Cooling Equipment

Reduce Evaporation by:

Reduce Drift Losses. Value < 0,05 % Flow. : Improvements in Drift eliminators

Reduce or Eliminate Evaporation:

Dry Cooler / Air Cooled Heat Exchanger. Needed proper Room conditions to apply technology



3.1.2 Water Cycle Approach – Contact

Contact Systems

PROCESS:
Metal Removing, Clarification, Filtering, Pumping & Cooling

FLOWS : up to 40000 GPM

TEMPERATURES DROP: 10 °F

- Important recirculating flow.
- Big impact in operational cost(energy)
- Big Impact in water needs
- Big Impact in Discharges Effluents
- Water characteristics impact on Operational Cost

3.1.2 Water Cycle Approach – Contact

Energy Saving

Flows Characteristics:

- Changing Flow depending on Product (important variations)
- Several Process, could work independently (IMPORTANT FOR SELECTION)
- Low-medium-High pressure.

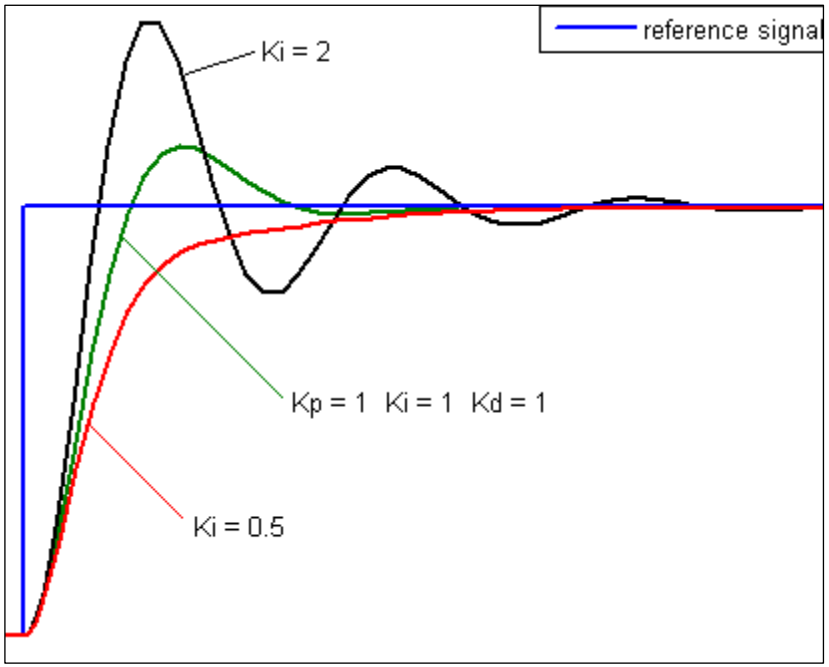
1 Pump System

- Depending on the area, different approach:
    - Scale Pit Pumps
    - Decanting are Pumps
    - Feed Pumps

3.1.2 Water Cycle Approach – Contact

Pump Group Control

Scale Pit & Decanting Area



PID Control

Pump Operating Set Point Range:

- *Decided by operator*
- *Set Point: Level in basin*

Pump Start/ Stop:

- All pumps same speed
- Start stops depending level changes.
- Due to flow changes, energy saving is important.

Pump Selection:

- Minimum number pumps to cover maximum flow and operated with variable speed.

3.1.2 Water Cycle Approach – Contact

Pump Group Control

Feed Pumps

Pump Operating Set Point Range:

- *Flow Control*
- *Pressure Control*

Pump Selection:

- Depending on product consumptions, decided the pumps number.
  - **MVT:** With low number pumps and variable speed.
  - **LVT:** More pumps with soft starter and depending on production.

3.1.2 Water Cycle Approach – Contact

2	Main Filtration	Traditional Approach

Common filtration System in the steel industry for contact systems (NO LAMINAR)

- **Decanting Basin :** 20-30 minutes retention time
- **Sand Filters** (selected by filtration speed / media depths/etc)
    - Oil Tramps before Filters
    - Sludge Removal (Auto or Manual)

OIL REMOVAL	SS REMOVAL
< 5 ppm	< 15 ppm

3.1.2 Water Cycle Approach – Contact

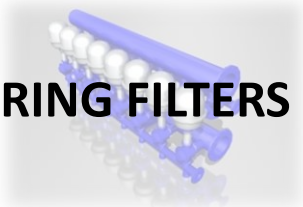
2 **Main Filtration** **New Approach**

Ring Filters instead sand filters

- **Decanting Basin :** 50-70 minutes retention time
- **Ring Filters microns**(selected depending on application) from 100 up to 200
  - Bridge Scraper to remove oil & sludge
  - Sludge and Oil Removal (Auto)

OIL REMOVAL	SS REMOVAL
< 5 ppm	< 15 ppm

3.1.2 Water Cycle Approach – Contact

	RING FILTERS 	SAND FILTERS 
SPACE OCCUPIED	MINIMAL	LARGE
WASH CYCLES	VERY BRIEF 4- 5 min	VERY LONG Mínimum 30 min
WASH WATER USED	LITTLE ~ 15 m^3	A LOT ~ 500 m^3
AIR USED FOR WASH	NONE	YES
PARTICLE SIZE	A GUARANTEED MINIMUM	CANNOT BE GUARANTEED
MAINTENANCE	EASY	COMPLICATED
LOAD LOSS	NORMAL	NORMAL
COST EXPLOITATION	MINIMAL	MAJOR
INVESTMENT COST	SIMILAR	

3.1.2 Water Cycle Approach – Contact

- Less area needs
- Less Energy Consumption
- Less Water needs for backwash
- Less chemicals needs
- Less maintenance cost
- Less CAPEX

LESS OPERATIONAL COSTS

3.1.2 Water Cycle Approach – Contact

Existing WTP systems to be studied before installing Ring Filters

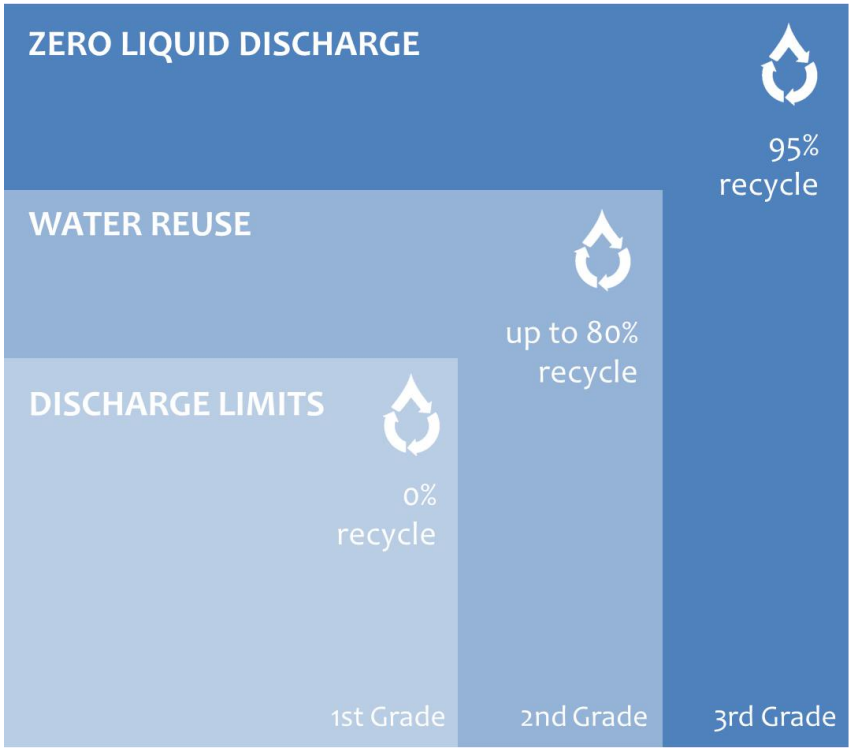
DATA TO STUDY

- Consistent design of the Water System
- Water System Layout
- Decanting Areas Dimensions
- Current water analysis before and after filtration
- Waste equipment description and location

DISCHARGE

3.1.3 Water Cycle Approach – Discharge

1	Options

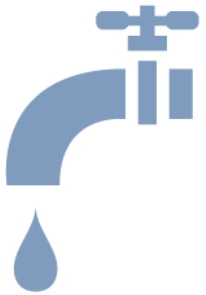


- Fresh water needs or environmental legislation force to treat the effluents and discharges.
- Depending on the final goal, there are three options to add value :
  - **Just Achieve the Discharge Limits**
  - **Reuse up to 80% of effluents**
  - **Zero Liquid Discharge System**
- It is an opportunity to reduce fresh water consumption and avoid discharges

3.1.3 Water Cycle Approach – Discharge

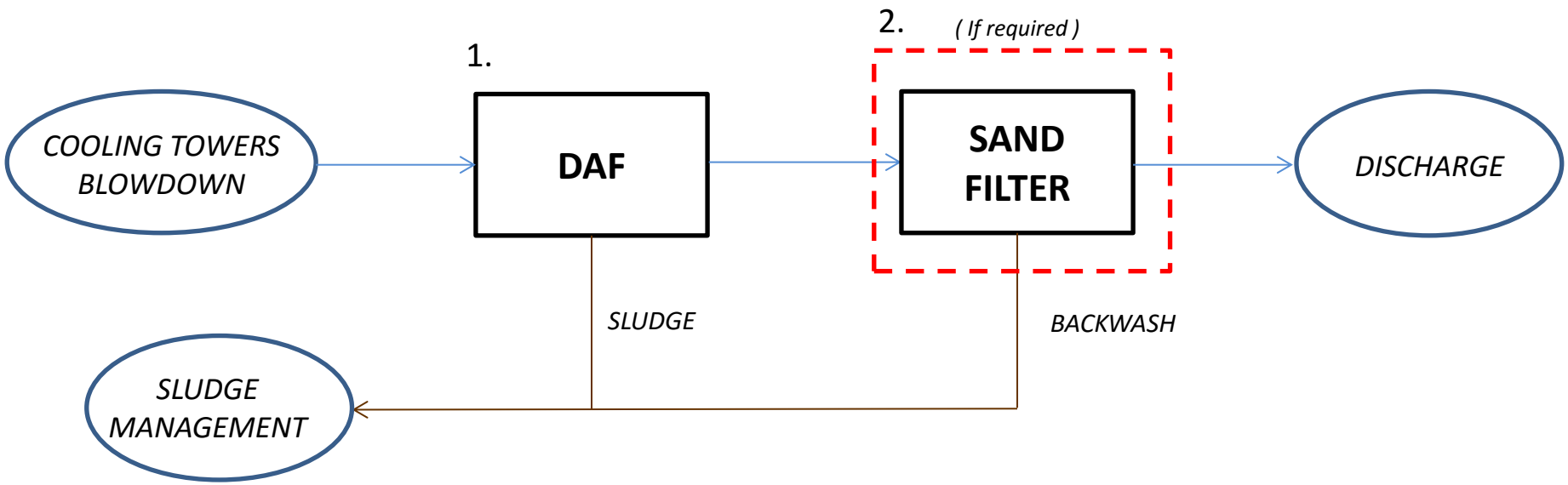
1.A **Achieve Limits**

- Obtain the discharge limits with the lowest CAPEX & OPEX
- Regarding Steel industry, TSS and oil are the limiting factor
- Substitute of traditional clarifier
- Low investment and easy maintenance



3.1.3 Water Cycle Approach – Discharge

1.A	Achieve Limits



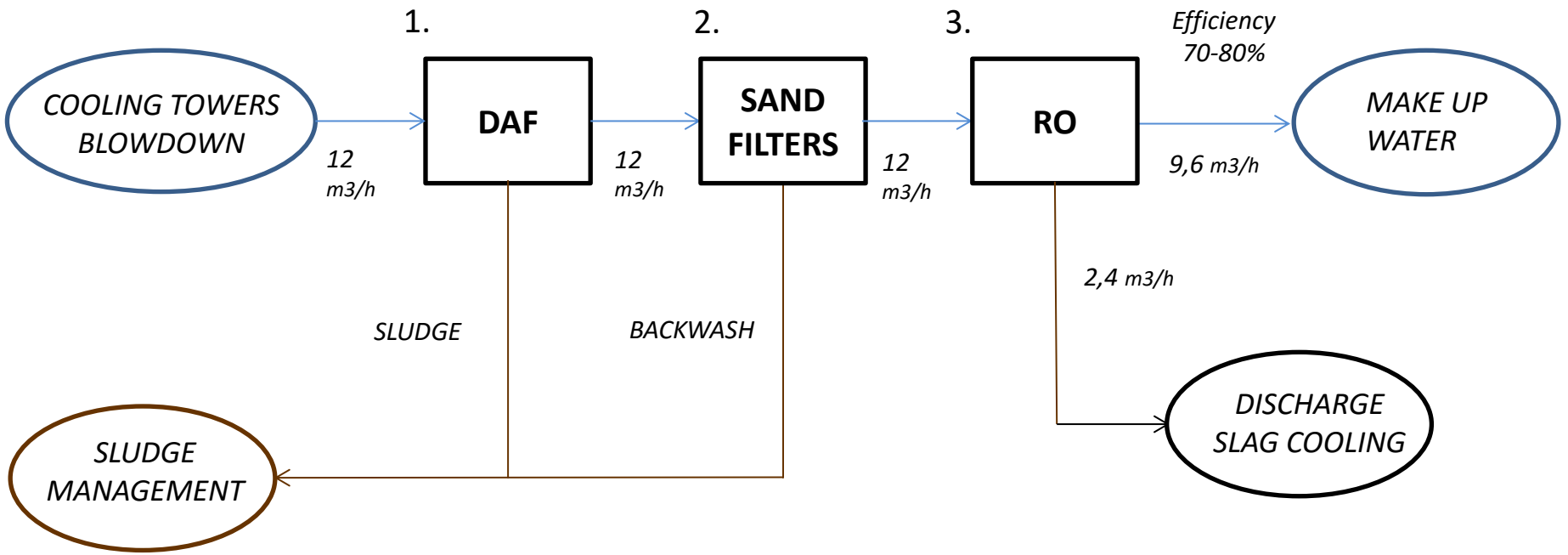
3.1.3 Water Cycle Approach – Discharge

1.B **Water Reuse**

- Focus on Cooling Towers Blowdowns
- Reverse Osmosis Technology to recover up to 80% water
- Pretreatment needed
- Reduce and improve make up water parameters

3.1.3 Water Cycle Approach – Discharge

1.B	Water Reuse



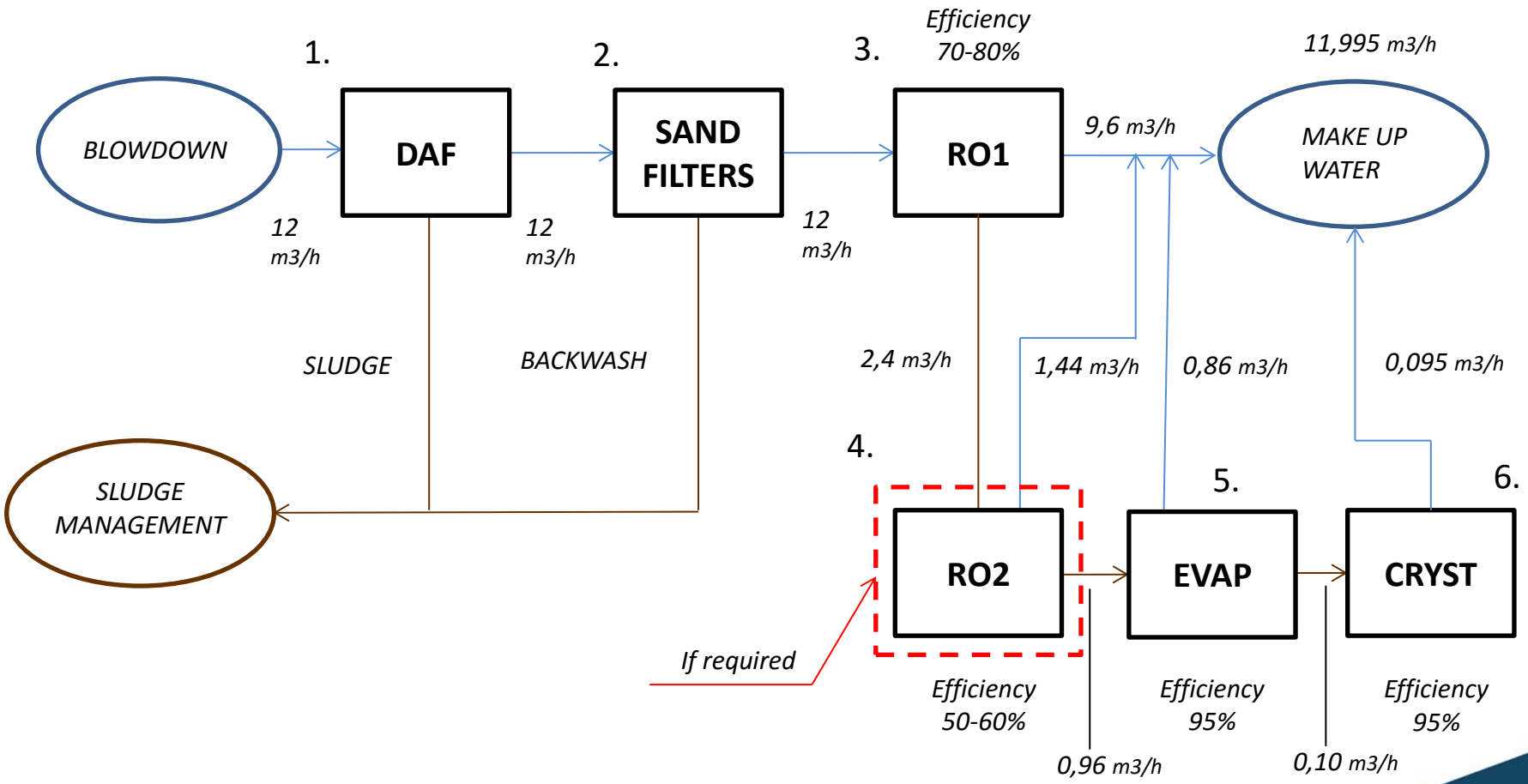
3.1.3 Water Cycle Approach – Discharge

1.C	ZLD

- Last stage of water recovering cycle
- Expensive solution for exceptional situations
- Important Heat needs
- Environmental friendly (Zero Discharges)

3.1.3 Water Cycle Approach – Discharge

1.C **ZLD**



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3.1.3 Water Cycle Approach – Make Up

1	Needs

- **PROCESS NEEDS:** Refill circuits due to:
  - Evaporation
  - Blowdowns
- **INDUSTRIAL NEEDS** *: Specific* Circuits
  - CCM Molds
  - Boilers
  - Cold Mill needs

3.1.3 Water Cycle Approach – Make Up

1.1 **Process Needs**

AUTOMATION IS KEY

EVAPORATION and BLOWDOWN:

Instrumentation installation :

- **Temperature Transducer in the Cooling Tower**: Accurate control of fans speed to not drop temperature under Set Point.
- **Flowmeter in Blowdown and make up water lines:** To control water volume discharged. Not introduce more water than needed into the system.
- **Conductivimeter installation:** Water quality control to increase CC and discharge only when needed.

3.1.3 Water Cycle Approach – Make Up

1.2 Industrial Needs

Specific production areas request a high water quality . Introduce high efficiency technology which is crucial to reduce operational costs.

Reverse Osmosis is the most effective way to obtained nowadays. Technology has developed until:

- Increase Efficiency
- Reduce Energy Consumption
- Extend membranes life
- Reduce fouling

4. Conclusions

- Current Water Systems have room for improvement.
- Water Systems must be aligned with main production line and new environment.
- Operational costs and water consumptions will be affected for good.
- Optimization could be carried out in phases to keep CAPEX under control.

WITHOUT WATER IT IS NOT POSSIBLE TO PRODUCE A SINGLE TON OF STEEL

WITHOUT PROPER WATER QUALITY, RESULTS IN LESS COMPETITIVE STEEL.

A WISE INVESTMENT IN WATER GIVES YOU A FAST RETURN ON CAPITAL INVESTMENT & OPERATIONAL COSTS