


DME-Seminar S-004-2017 – Presentation 01
Water Intake Technology - Systems and Solutions/Components

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Water Intake Technology Systems and Solutions/Components

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Karlsruhe

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Water Intake Design for New Plants and Retrofit Possibilities for Existing plants

P F Rowles



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We have to discuss both Open Channel and Tunnel Intakes



Mobin in Iran is a
Tunnelled Intake

In this talk we are discussing screens and
the screening chambers of both types of intake

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Water Quantities
of up to 200m³/sec
are required by
certain industries

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Desalination Plants



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Large Industrial Complexes



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Common Cooling Water Intakes

These are used as a common intake for all three of the previous industries and are by far the largest of all intakes sometimes up to 500m³/sec

Ras Laffan in Qatar, Sohar in Oman and Mobin in Iran are examples of common cooling water intakes



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Cooling Water is essential for Power Plants and Industrial Complexes

- Without a reliable source of screened cooling water these plants cannot operate.
- Once through cooling systems are without doubt the most secure.
- Beach wells have capacity problems and a limited life.
- Cooling towers are unsightly, can be a source of pollution and typically provide lower energy efficiency than water-cooled systems.

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Seawater feed for Desalination Plants must be debris free and always available whether the process is:-

THERMAL	FILTRATION
Multistage Flash (MSF)	Reverse Osmosis(RO)
Vapour Compression (VC)	
Multi Effect Distillation (MED)	

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Seawater has to be screened to protect downstream plant

- Large water abstraction rates for any of these industries will often mean dealing with very large volumes of debris . . .
 - Fish
 - Weed/Sea Grasses
 - Jelly Fish (a growing problem in the Middle East)
 - General debris, plastic bottles etc.

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coming off the screens

Jelly Fish in the Intake Chamber about to enter the screens

disposal of jellyfish

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Where do we begin the design process?


- Location.
- Seawater Levels.
- Degree of filtration required... What are we protecting?... Pumps? Condensers? Plate heat exchangers? Membranes?
- What legislation is being applied... 316b, SEPA EPA, Natural England Eel regulations etc.
- What Delta is being applied between inlet and outlet seawater temperatures.

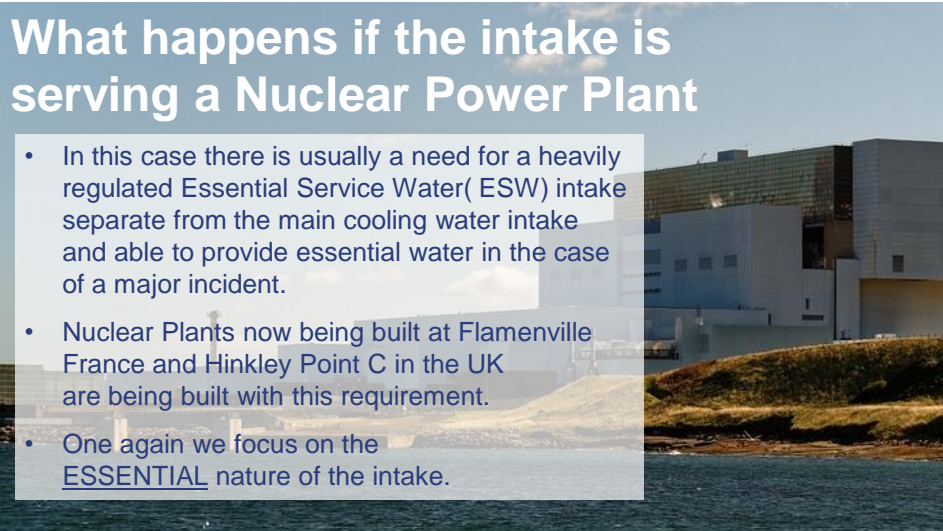
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What happens if the intake is serving a Nuclear Power Plant


- In this case there is usually a need for a heavily regulated Essential Service Water(ESW) intake separate from the main cooling water intake and able to provide essential water in the case of a major incident.
- Nuclear Plants now being built at Flamenville France and Hinkley Point C in the UK are being built with this requirement.
- One again we focus on the ESSENTIAL nature of the intake.



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What type of screen is best for the intake being designed

- We firstly have to define what a "Fine Screen" is . . .
- Usually the second stage of the screening process and . . .
- This can be . . .

Drum Screens	Band Screens	MultiDisc Travelling Screens
		


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Fine Screen Protection

All three of these options are usually protected with a coarse screen of some description . . .

Fixed Head / Cable-oper.
Raking Machine

Overhead Gantry
Mobile Screen

Continuously Raked
Chain Screen





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What screen suits what intake?

- We have at this point to discuss unit capacity of the fine screen... Noting, the design point is always MAX unit flow at the LWL that meets the velocity or headloss criteria.
- Drum screens can handle up to 50m³/sec/each
- Band Screens are usually limited to about 15m³/sec/each
- Multi Disc Screens have similar capacities to Centre-Flow/Dual Flow Band Screens

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The design point

Headloss across the intake needs to be minimised.

Headloss increases exponentially with Velocity

The design basis must always have the screen, any type of screen, operating on the flat part of the curve...

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Headloss as a Function of Mesh Blockage at LWL
Maximum Design Flow of 20m³/sec at LWL

Degree of Mesh Blockage (%)	Headloss Across Screen (mm)
0	0
10	200
20	300
30	400
40	500
50	600
60	800
70	1200
80	1400

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So, we have started the design process

A medium capacity screen dealing with flows up to 15m³/sec per channel with very large tidal ranges between LWL and HWL may lead to the selection of Travelling screens as the best Capex option.

Very large unit flows up to 50m³/sec/screen will almost certainly result in the Drum Screen option.

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FLOW DIRECTION IN-TO-OUT

With Roof-Shaped Panels With Flat Panels

Unscreen Flow in
Screened flow out

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What else must we consider when in the conceptual planning stage

- Life time running costs
- Ease of maintenance
- Materials of construction
- What anti corrosion systems shall be used (ICCP is recommended)
- Support from suppliers etc.
- Is it a BOO or BOT project




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Caution is needed when advising clients

There are minor Screen makers operational in other parts of the world but track record must be considered. It is therefore sensible to consider at this point only the major players when planning what is best for a particularly large or complex projects.

Clients do not always follow advice and the consequences can be disastrous



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Drum Screens on a Desalination Intake



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Band Screens on a Power Station Intake



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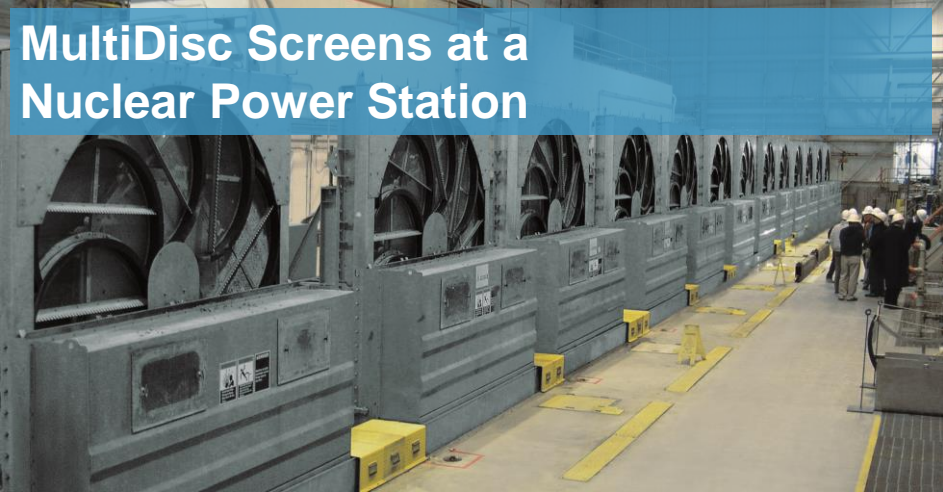
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MultiDisc Screens at a Nuclear Power Station



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What if the plant exists but operates inefficiently causing downstream problems?

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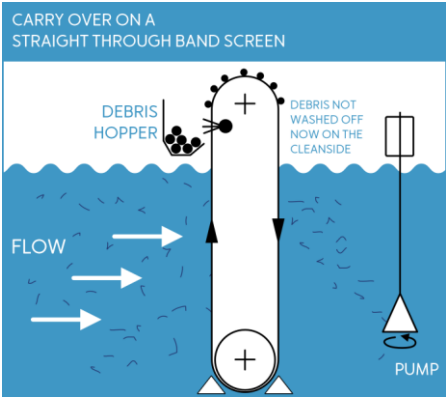

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Dealing with Brown Field Sites

For many years the Straight Through Band screen was the only fine screen available in the US and the huge domestic market available to US screen makers led to many American screen makers continuing to supply the Straight Through Band screen with all its inherent problems.




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Thousands of Straight Through Screens are operational worldwide

The consequences of “CARRY OVER” was considered an unfortunate fact of life by many plant operators, because the flow is at 90 degrees to the mesh any debris not removed from the mesh on the rising side was deposited on the clean side of the screen . . . with all the ensuing downstream problems

This was a serious fault with US straight through screen intakes and presented a real challenge...how to solve the problem without having to rebuild the intakes completely

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European screens supplied by the companies referred to earlier cannot CARRY OVER

- Dual Flow Band screens cannot Carry Over
- Central Flow Band Screens cannot Carry Over
- Double Entry Drum Screens cannot Carry Over

However . . . the civil work for all of the above is quite different to the parallel intake chambers for Straight Through Band Screens.

Making Retrofits very difficult to undertake . . .

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The Solution

The Multi Disc Screen is an innovative solution to the problem, it can be fitted into existing Straight Through civil works, has ZERO carry over and as water passes through to mesh only once and in a laminar stream it reduces headlosses. The retrofit market in the US was the initial home for the Multi Disc Screen.

It is however gaining ground in Green Field sites all over the world as the civil works is greatly simplified. It can also incorporate an excellent fish recovery system. The Barka Desalination Plant in the Sultanate of Oman is a typical example of this solution on a new plant.




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Intakes . . .

So many options, So many solutions

- This presentation is a brief resume of the design process and some possible solutions
- In a short presentation such as this we can only touch on the subject in very broad terms
- What we probably agree on is that experience can be a great teacher
- Learning from past experiences is what we all do . . .




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Conclusions

- Intakes must provide a reliable and uninterrupted source of screened water etc.
- Must be easy to maintain
- Have at least 40 years of useful life
- Minimise operating costs

Seawater Solutions can help ensure
that these aims are delivered.
THANK YOU FOR LISTENING



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