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Behind the **Desert Dragon** by: David Stables and Edwin Lillie



Neckartal Dam



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Dam location

7hrs drive
from
Windhoek or
Upington



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Bird's Mansions Hotel - early site office!



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Schützenhaus - overnight stay



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Little Italy - Management area

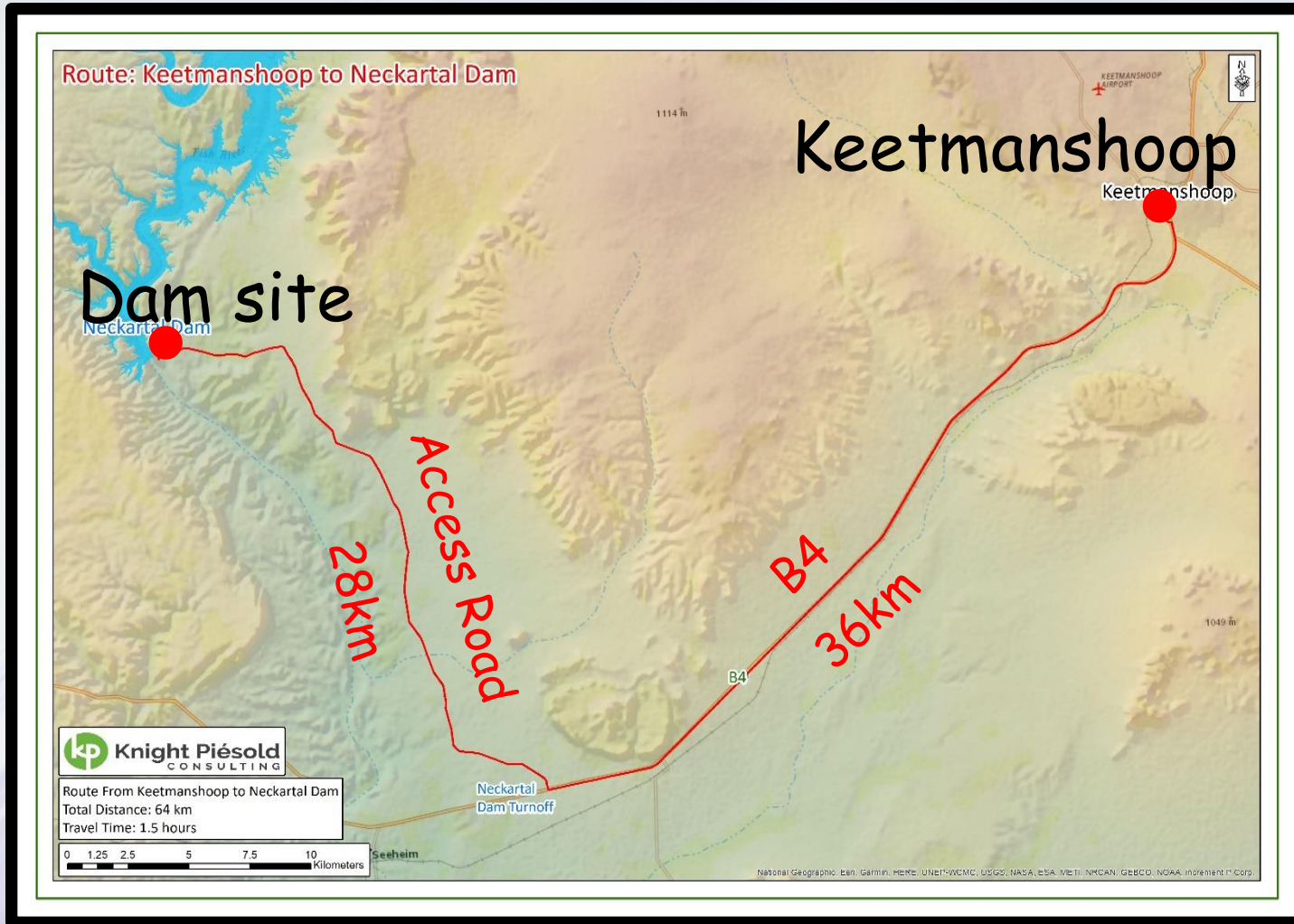


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Little Italy - Dining room & Bar Lapa



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The Access Road : concrete up to the office area

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Entrance to the quarry - 12km from dam



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Mobile Crusher - hard at work



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Crushing Plant



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Crushing Plant - imported



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The Fish River – with no dam wall

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Forming the terrace for Offices & Batching Plant

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Cooling Plant for refrigeration of materials



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Coffer dam to enable work during river flow



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Wall being raised fully across the river width



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Working around the clock



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Perspective at the upstream face of the wall



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Site Conditions
Specifications
RCC Mixes
Aggregates
Temperature Control
Production Rates
Quality Control

**Roller Compacted
Concrete (RCC)**



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Site Conditions

- Distance for cement - 1 000 km
- Distance for fly ash - 1 200 km
- Desert - temperatures!
- Source of aggregates
- Quantity of RCC 836 000m³



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- **Customised for the project**
- **“Two RCC mixes”** to suit dry and remote site conditions
- Fine and coarse aggregates specifications
- Range of mix proportions
- Plant requirements
- Temperature controls + max. temperature
- Quality Controls
- **Different to “SANS 1200” approach**



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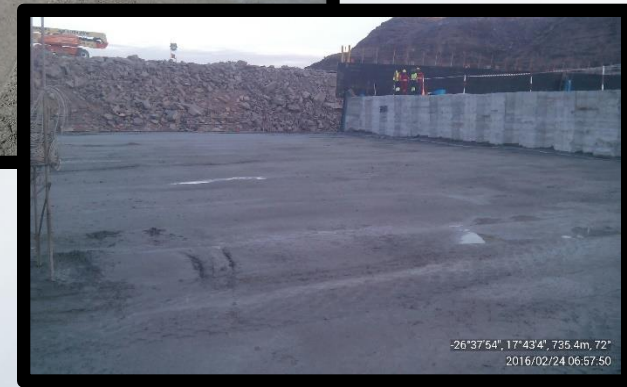
Mix Proportions

Cement & FA content

Zone 1 = 65kg & 120kg = 185kg

Zone 2a = 65kg & 20kg = 85kg

Zone 2b = 65kg & 45kg = 110kg



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Aggregate Specifications

- **Coarse Aggregate:**
 - Dolerite Quarry
 - Two sizes 19mm & 38mm
 - FI & EI < 25% (Contractor achieved 35% after adjusting plant)
- **Fine Aggregate:**
 - Dolerite quarry
 - River sand
 - Or blend of river sand & crushed dolerite
 - 0.15 - 1.18mm at least 55% (Contractor achieved 40%)
 - Less than 0.075mm - 5% to 18%
 - Void Ratio < 32% (Contractor achieved 35%)
- Contractor chose not to use river sand



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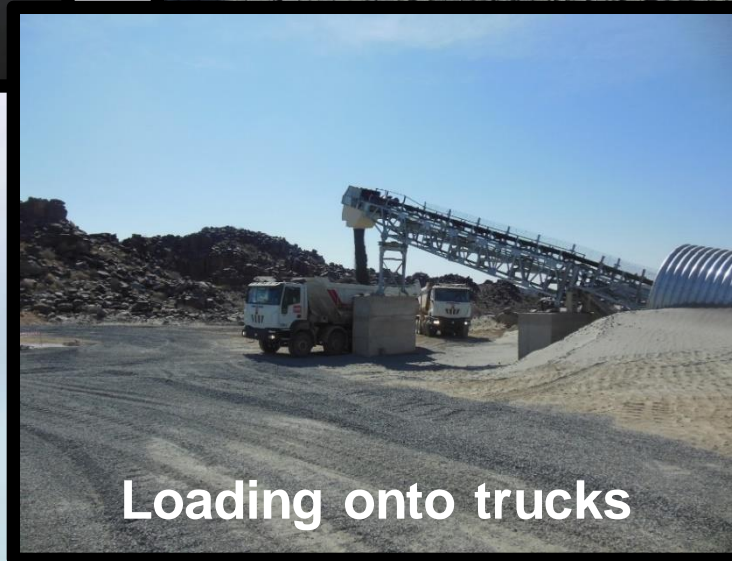
Poor shaped aggregate, early in the Project timeline



Much better shape after plant adjustments



Aggregate stockpile



Loading onto trucks



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RCC Aggregate Production

Contractor set up a 600t/hr crushing plant

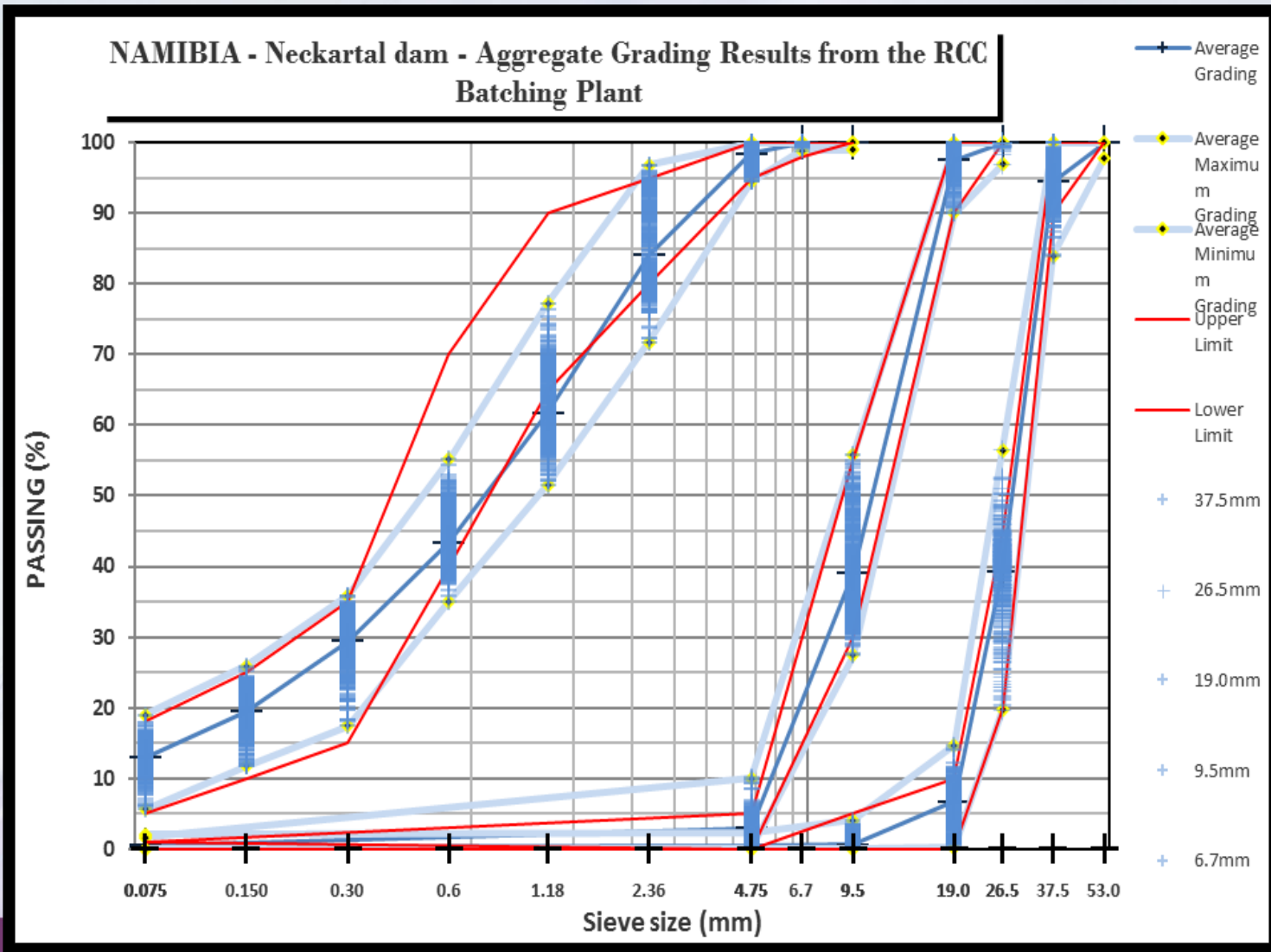
- Coarse aggregate crushing & screening;
 - Primary — 2 x Jaw Crushers (0 - 250mm)
 - Secondary — 1 x Secondary jaw + 1 x Primary cone
 - Tertiary — 1 x Secondary cone crusher
 - Quaternary — 2 x VSIs
- Fine Aggregate crushing;
 - Quinary — 2 x Rod mills

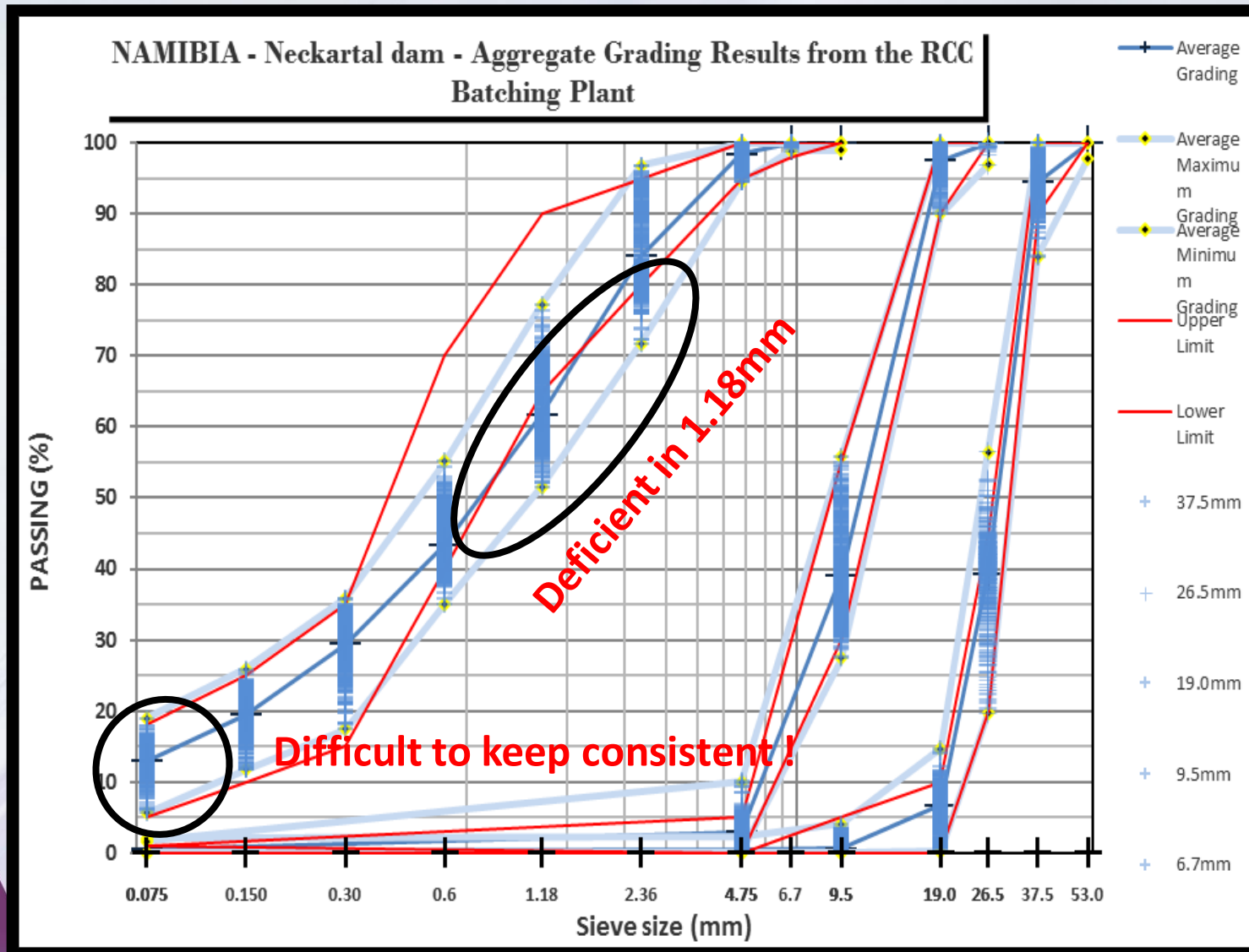




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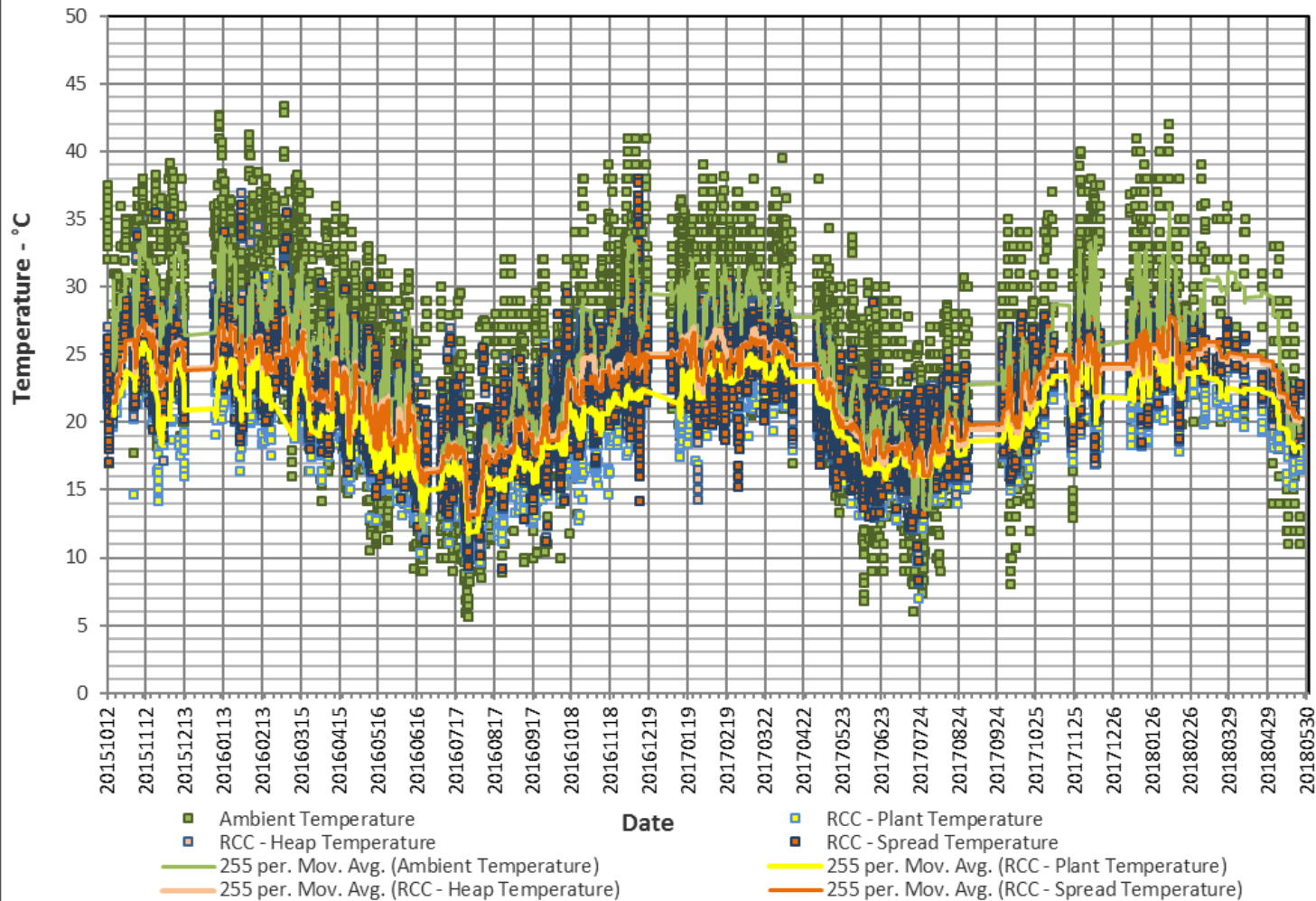


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NAMIBIA - Neckartal dam Temperatures



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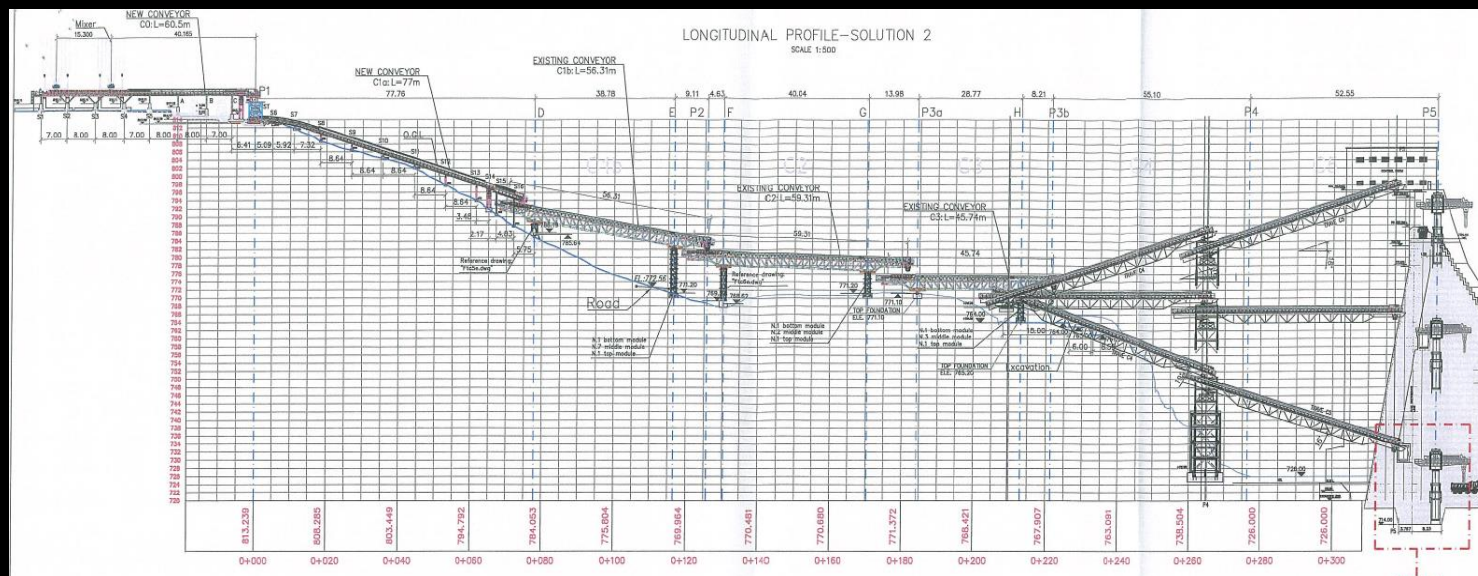
Cooling Plant & Insulated Silos



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RCC production capacity and transport

- Minimum plant capacity of 300m³/hr
- Conveyor used to transport RCC onto dam wall

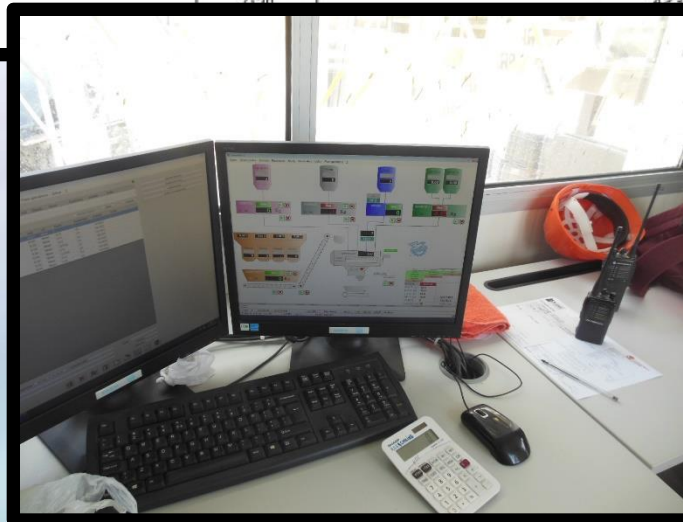
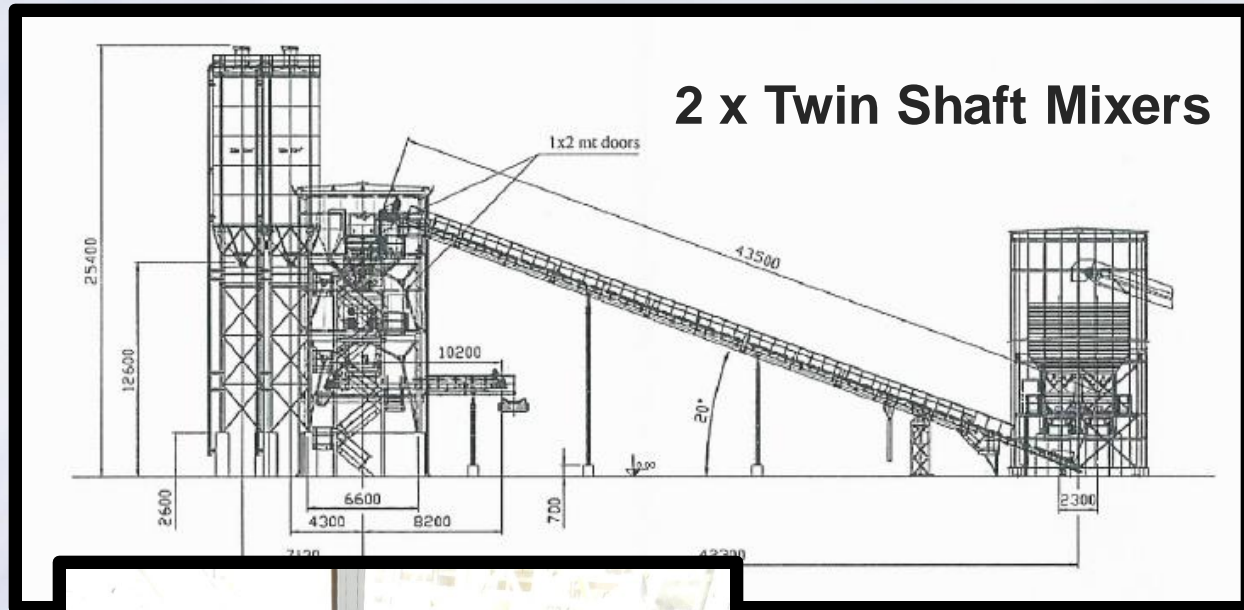


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Batching Plant (320m³/hr)



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Neckartal Dam RCC – Target Production rates

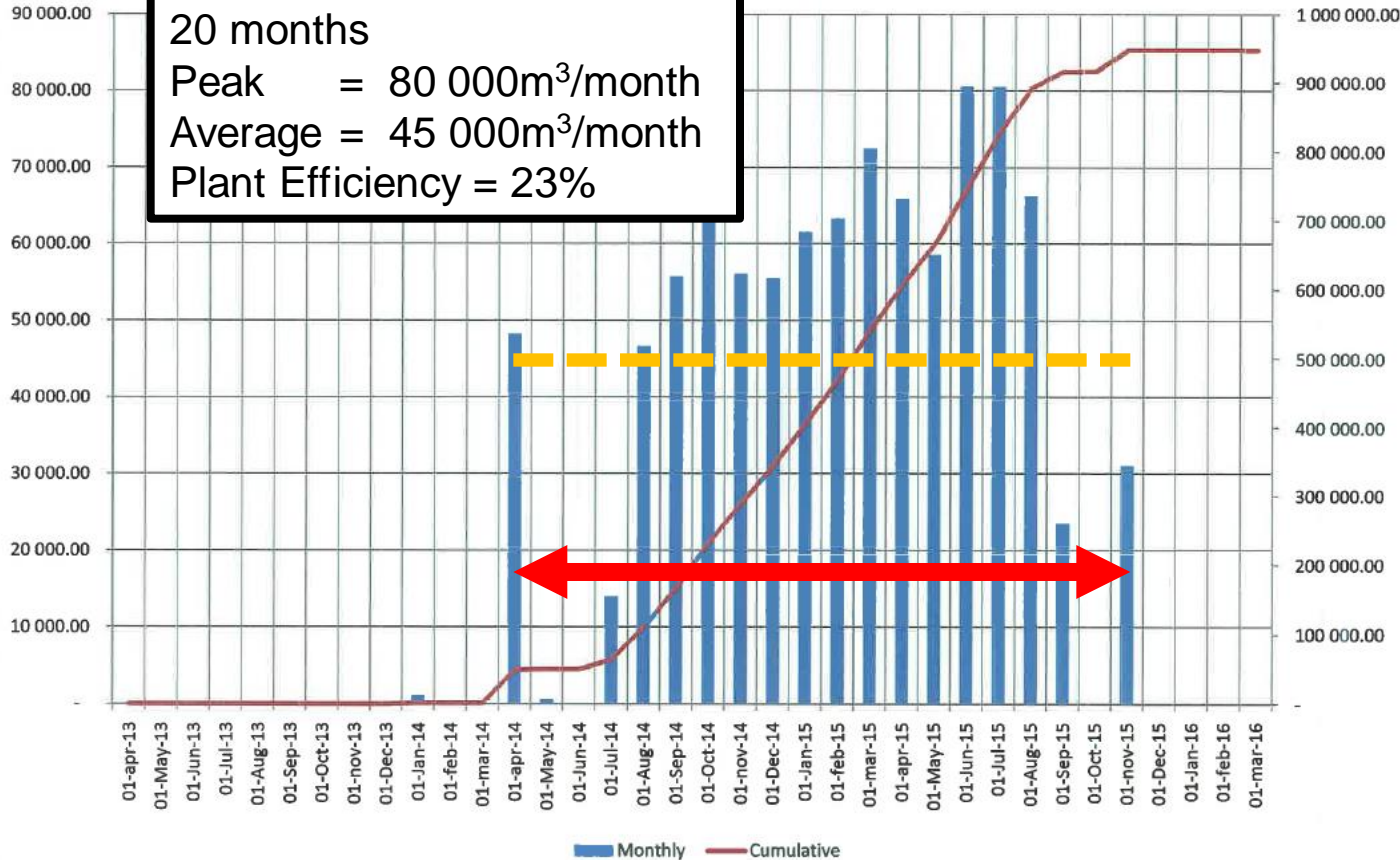
RCC (m3)

20 months

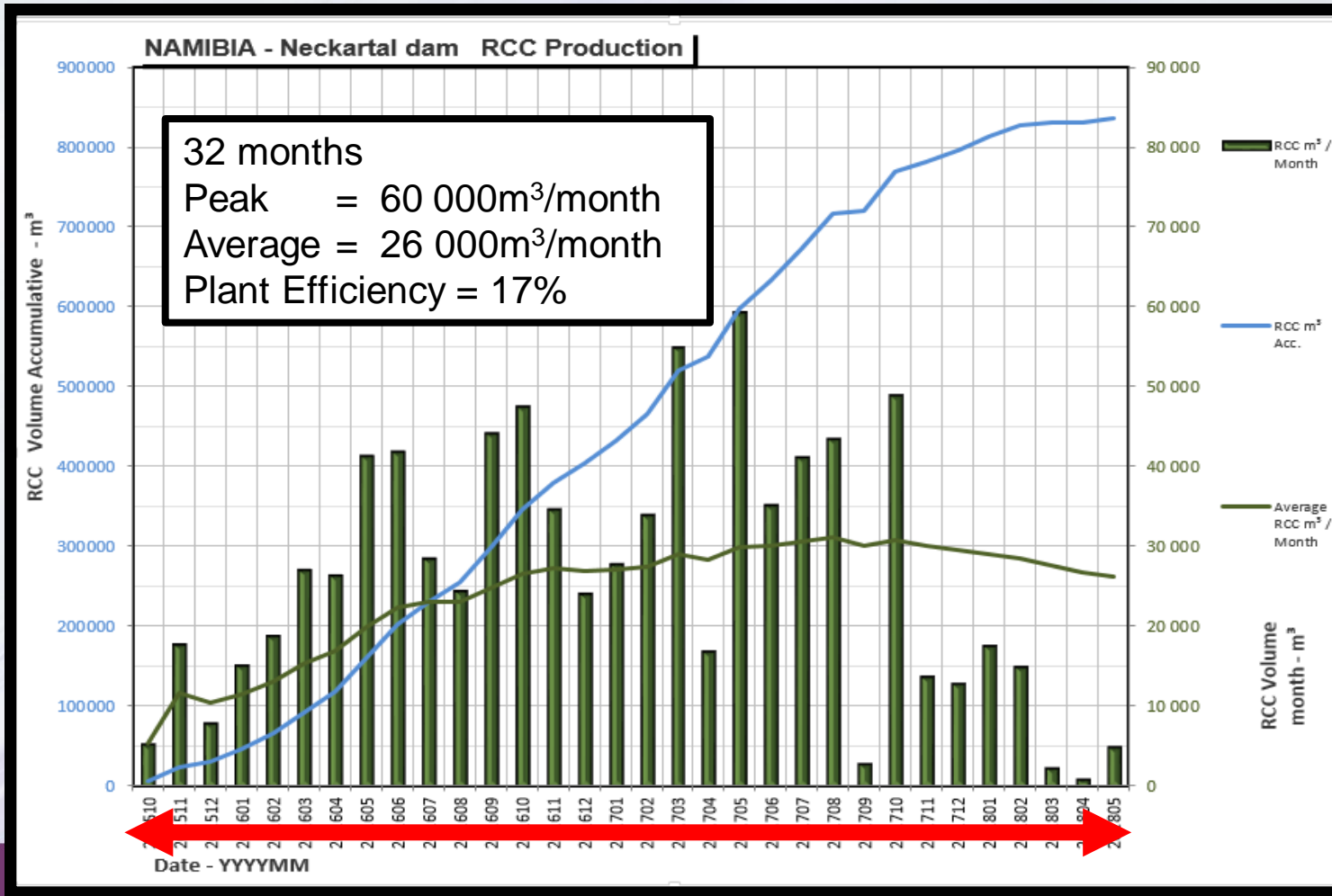
Peak = 80 000m³/month

Average = 45 000m³/month

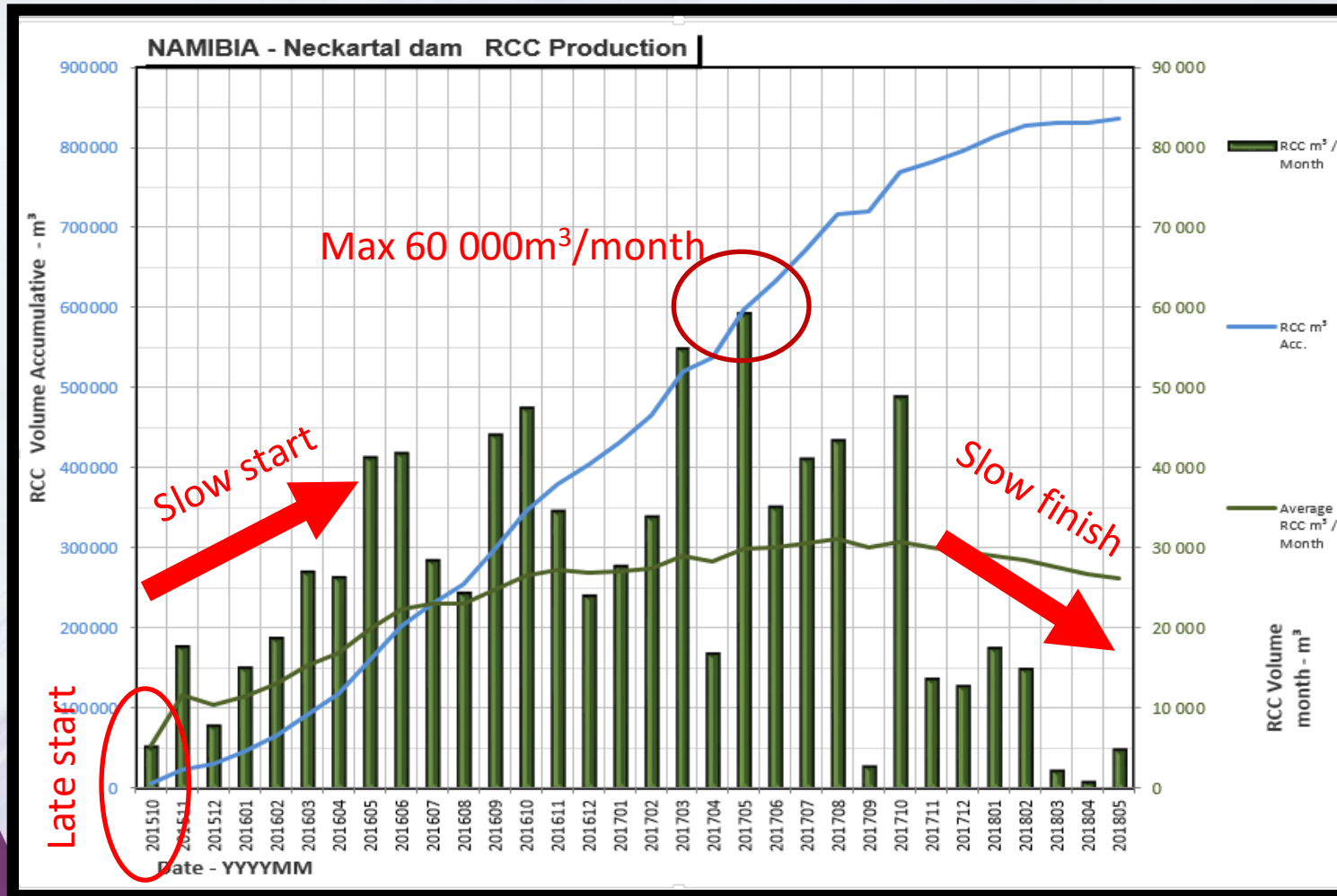
Plant Efficiency = 23%



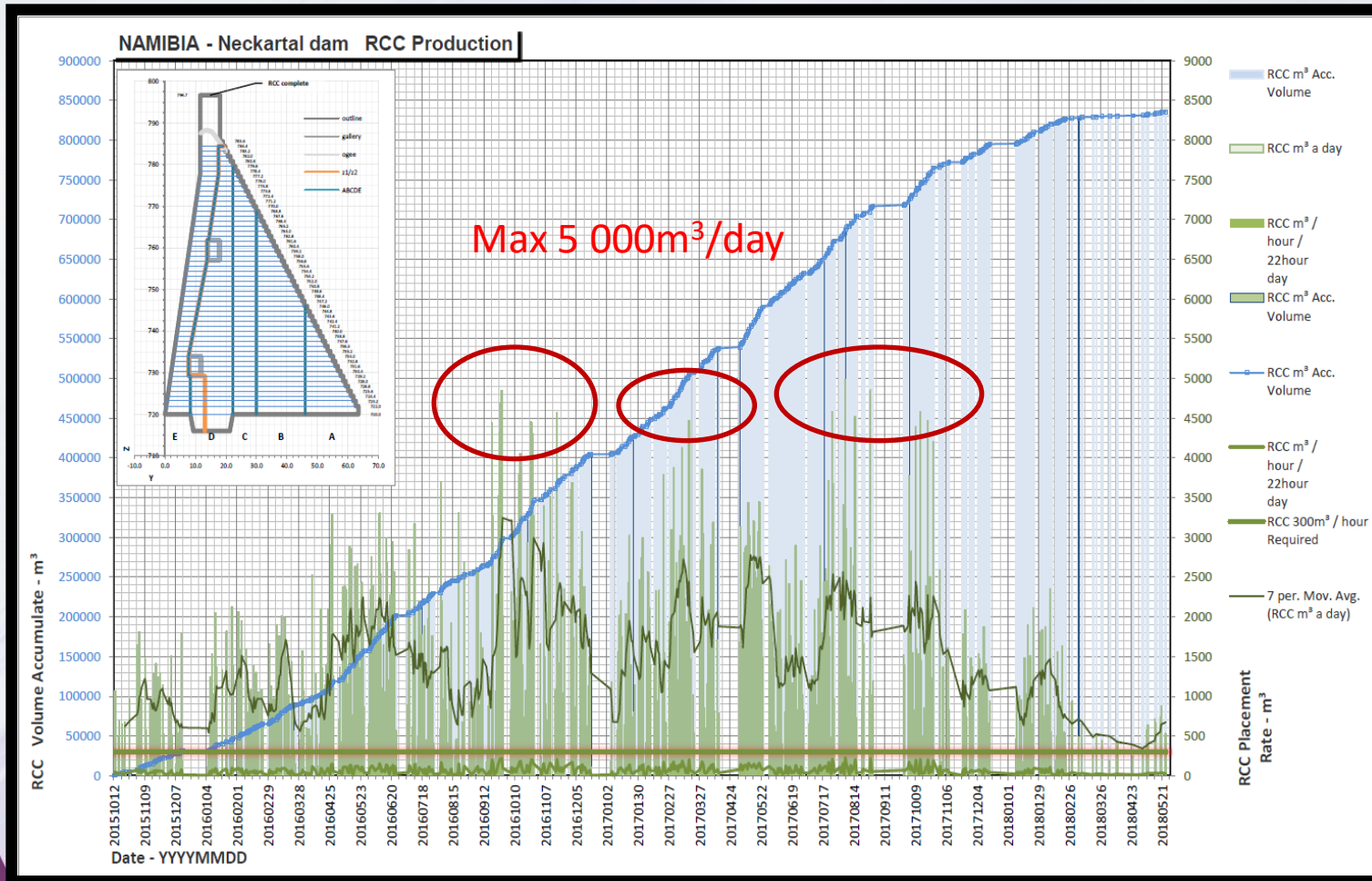
Actual RCC Production



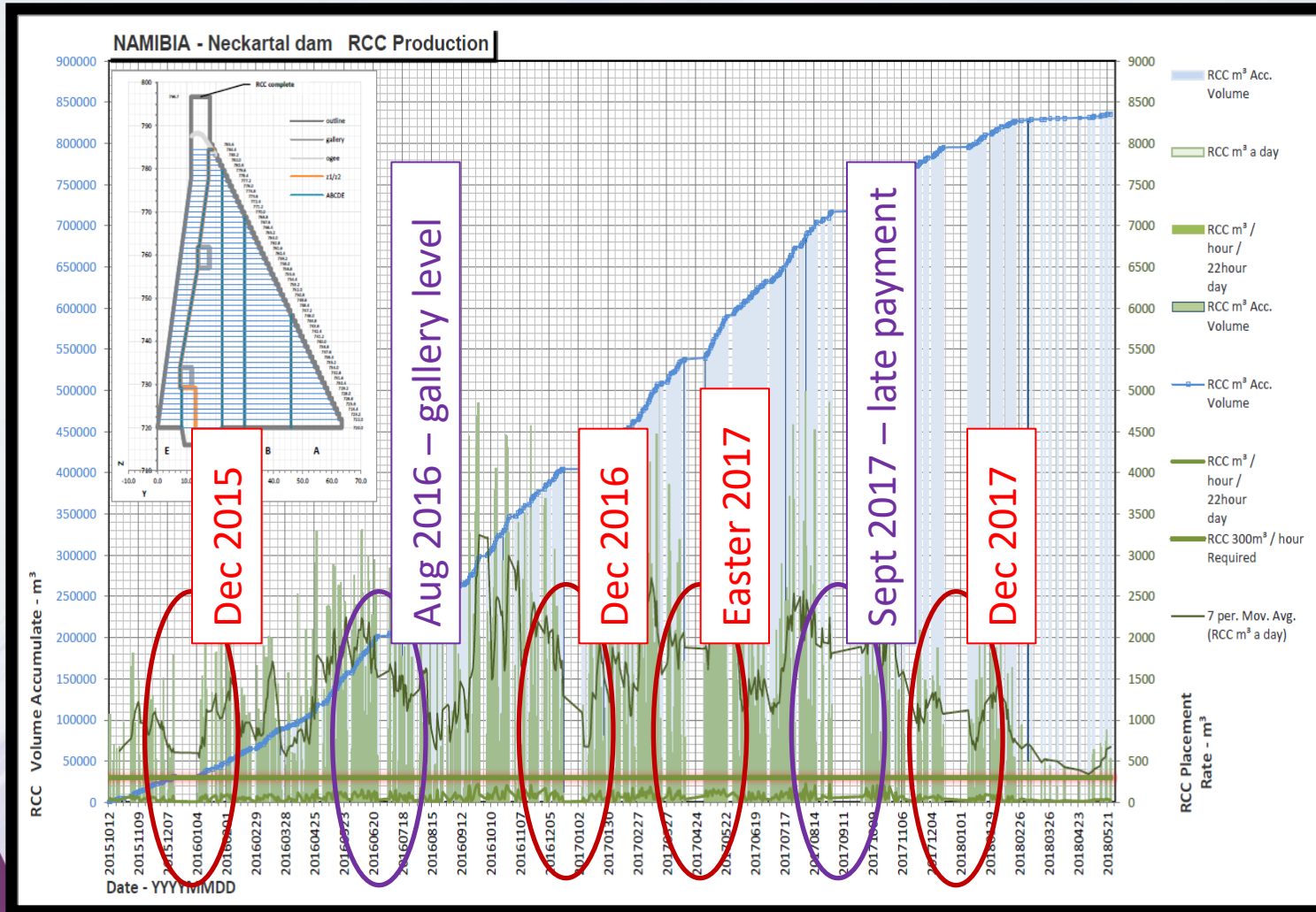
Actual RCC Production



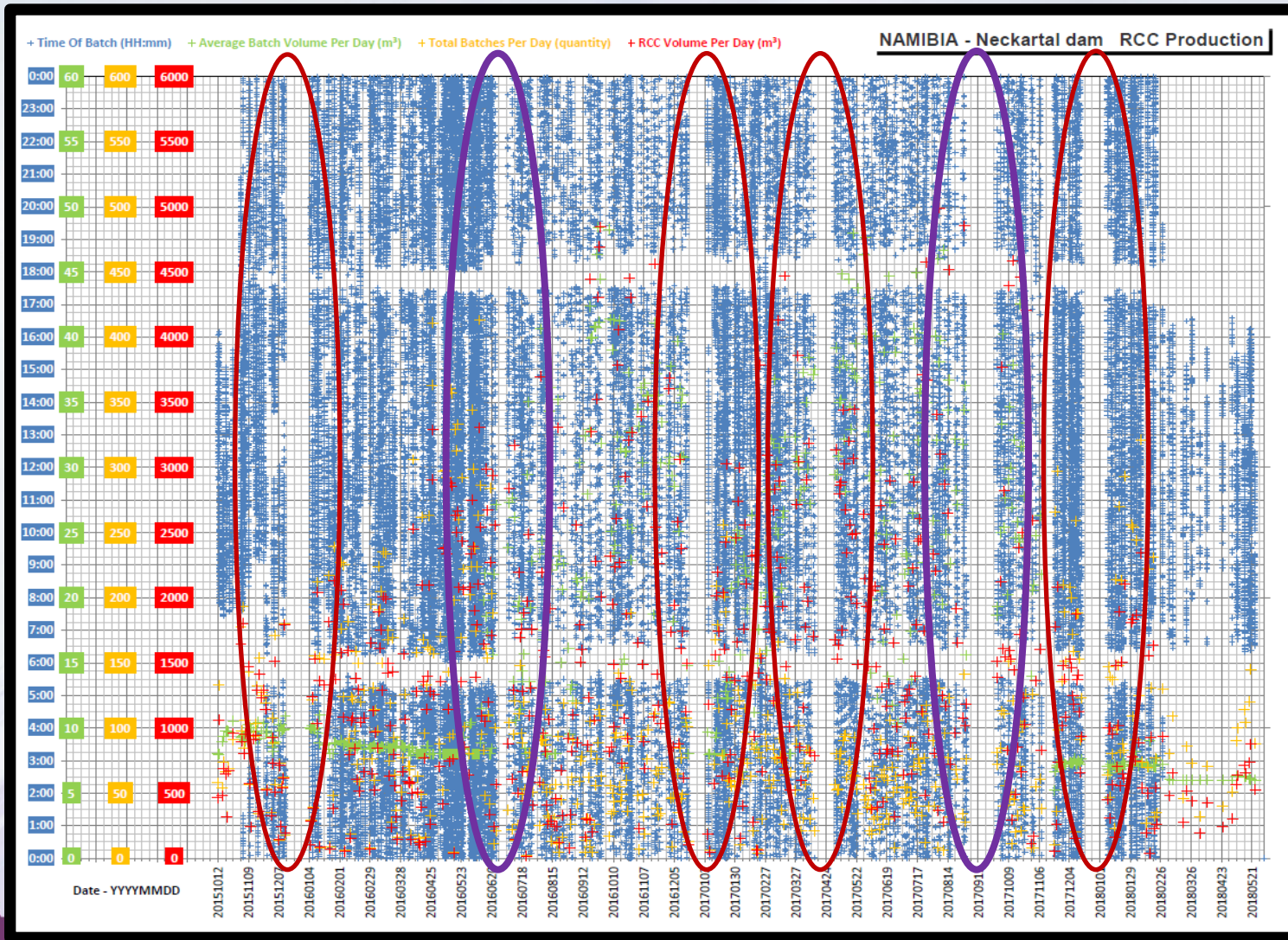
Daily RCC Production History



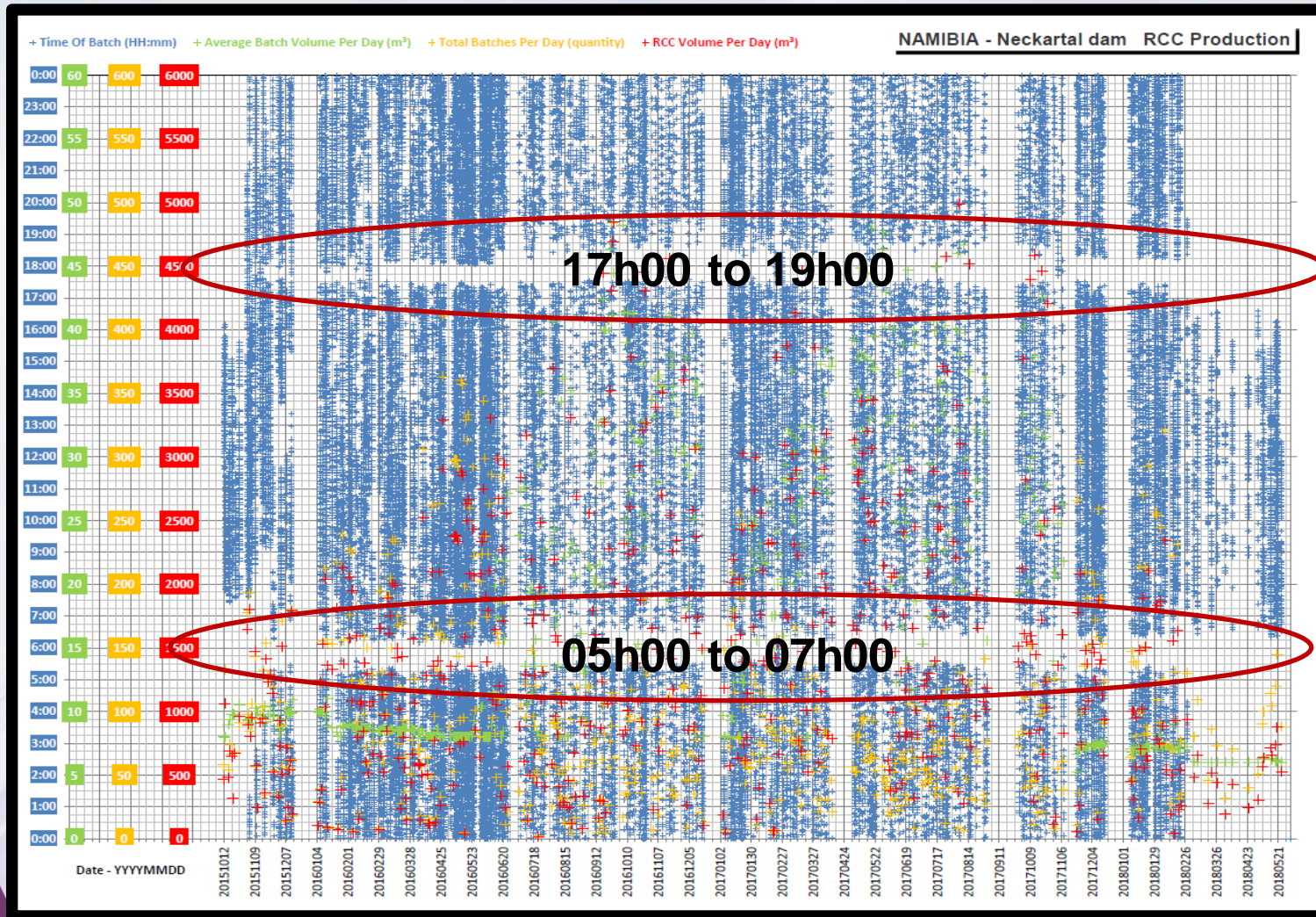
Daily RCC Production for the dam



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RCC Production Efficiency Parameters

Two guideline parameters for efficient RCC Production
(QHW Shaw - SANCOLD 2017).

- Peak month/average month should be less than 2
- Peak month/peak day should be greater than 20
- Actual peak month/ average month of 2.3 over 32 months
- *(Actual peak month/ average month of 1.6 over 18 months)*
- Tender peak month/ average month of 1.8 over 20 months
- Actual peak month/peak day of 12
- Tender peak month/peak day of 16



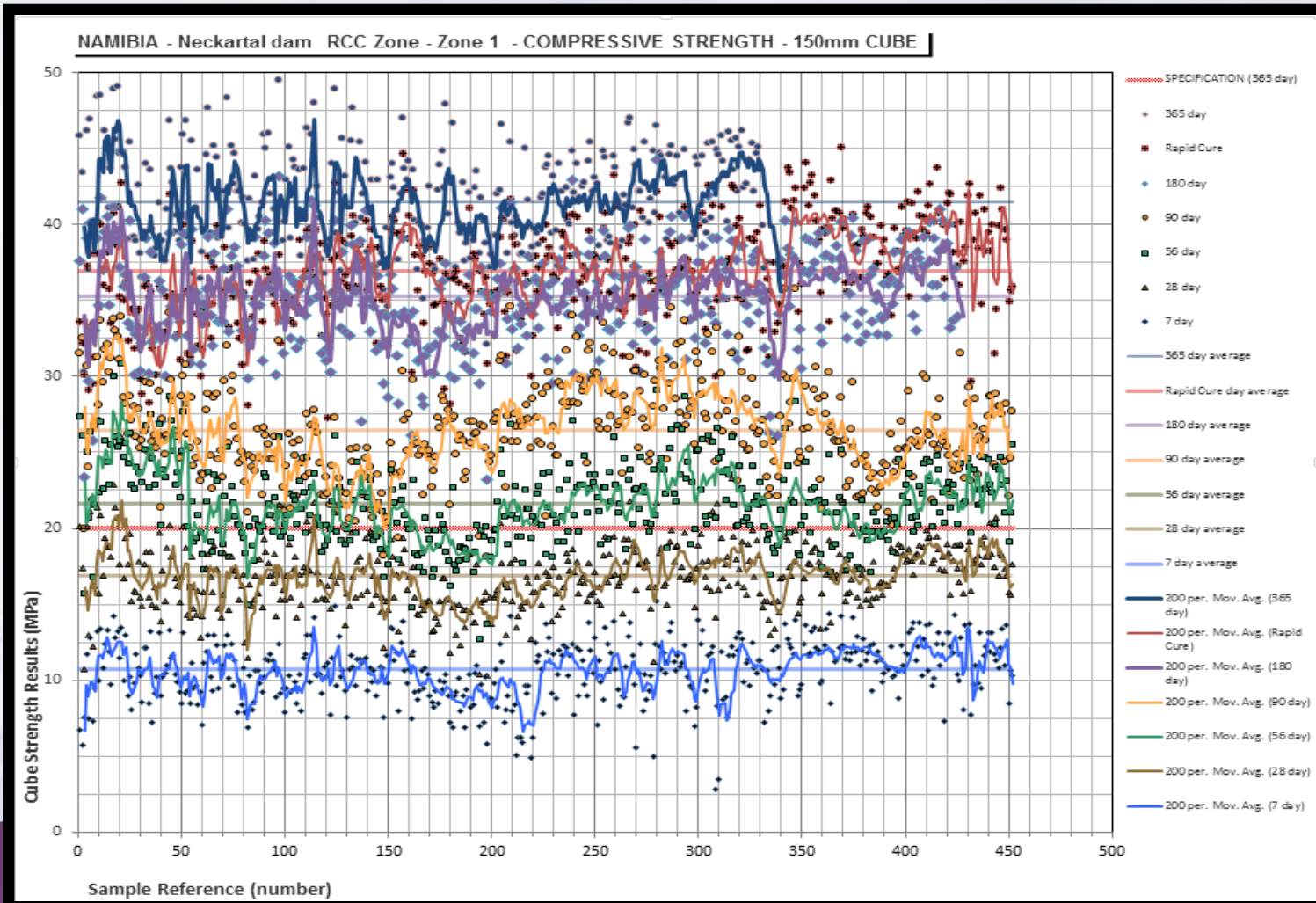
RCC Production Efficiency Parameters

- Another guideline parameter for efficient RCC Production is the average number of hours an RCC Plant operates at Peak Production Capacity (MRH Dunstan, CHINCOLD 2015)
- According to M Dunstan's records, the average for this efficiency factor for all RCC dams completed up to 2015 was **94hrs per month**, with a range for the worst case of 13.5hrs per month to the best case of 196hrs per month.
- **Neckartal actual** average monthly of 82hrs over 32 months
- **Neckartal actual** average monthly of 113hrs over 18 months
- **Neckartal Tender** average monthly of 140hrs over 20 months



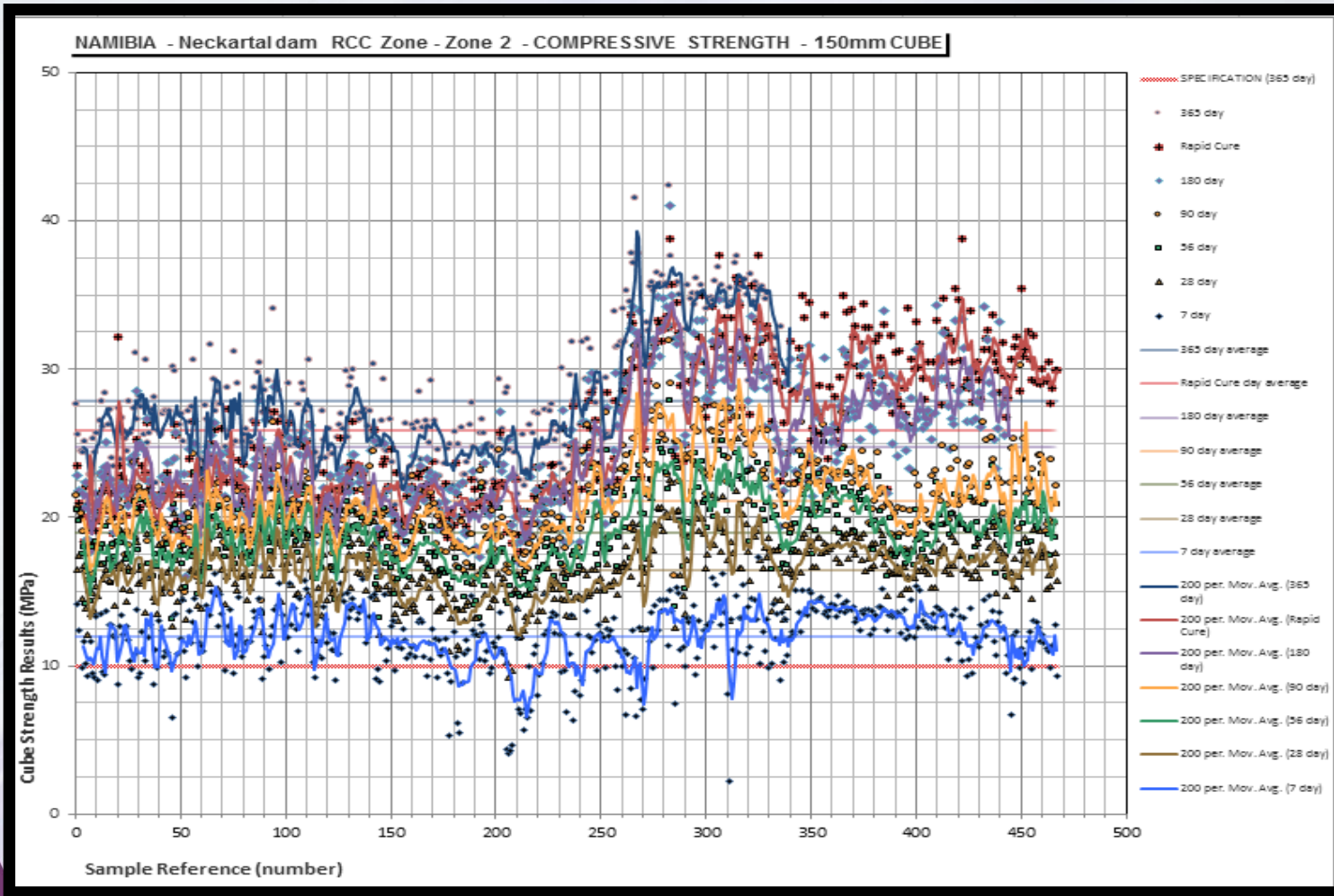
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RCC Zone 1 - Compressive Strength



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RCC Zone 2a & 2b - Compressive Strength



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ZONE 1 MIX CODE 051.

Zone 1



ZONE 2 MIX CODE 052.

Zone 2



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ZONE 1 MIX CODE 051.

Zone 1



ZONE 2 MIX CODE 052.

Zone 2



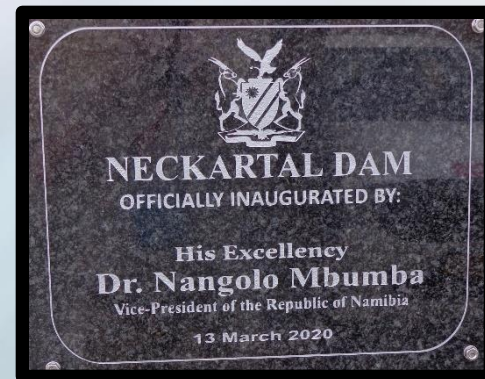
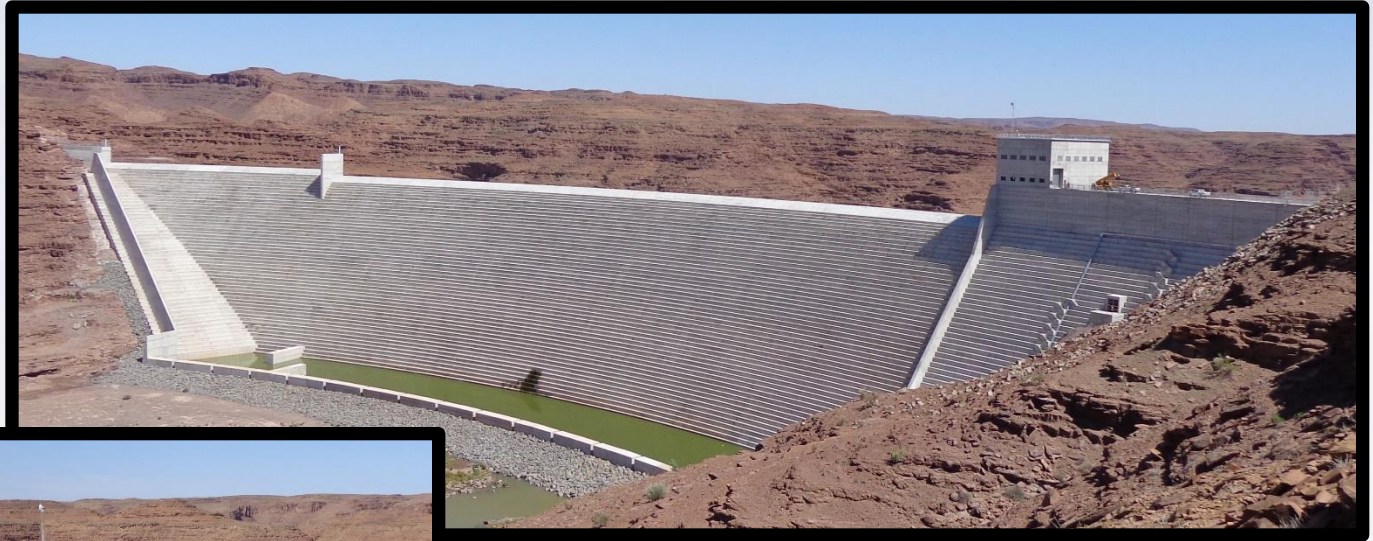
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**Topping
out**



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Overtopping is always spectacular !



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Behind the **Desert Dragon** by: David Stables and Edwin Lillie



to the Germans

to the South Africans

to the Italians

to the Namibians



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Use your
imagination ...
to see ...
the ...

Desert Dragon



aerial view
of the
catchment
area

