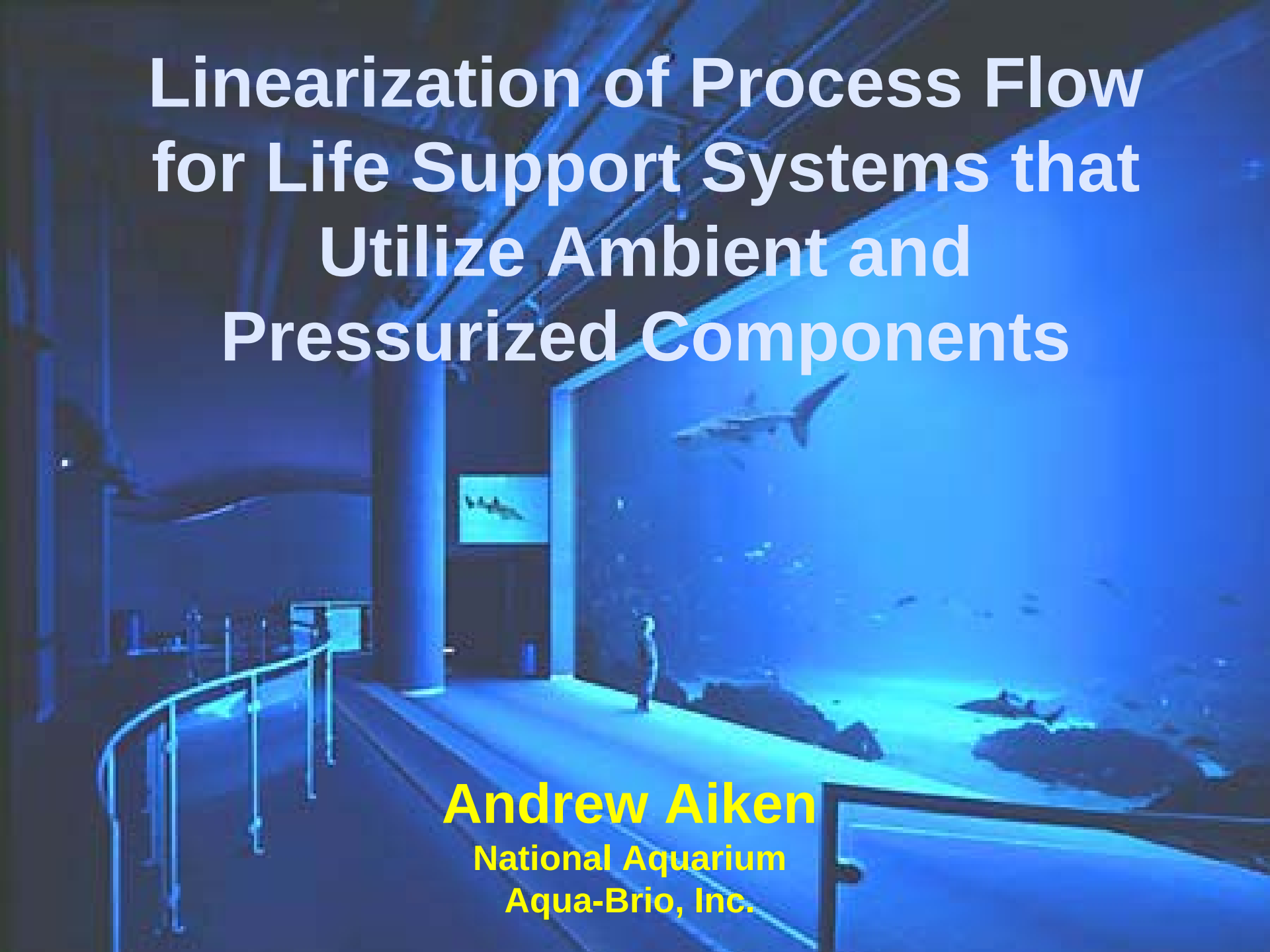
Linearization of Process Flow for Life Support Systems that Utilize Ambient and Pressurized Components



Andrew Aiken
National Aquarium
Aqua-Brio, Inc.

Intro

Andrew Aiken aaiken@aqua.org

Intro

- Ocean Voyager

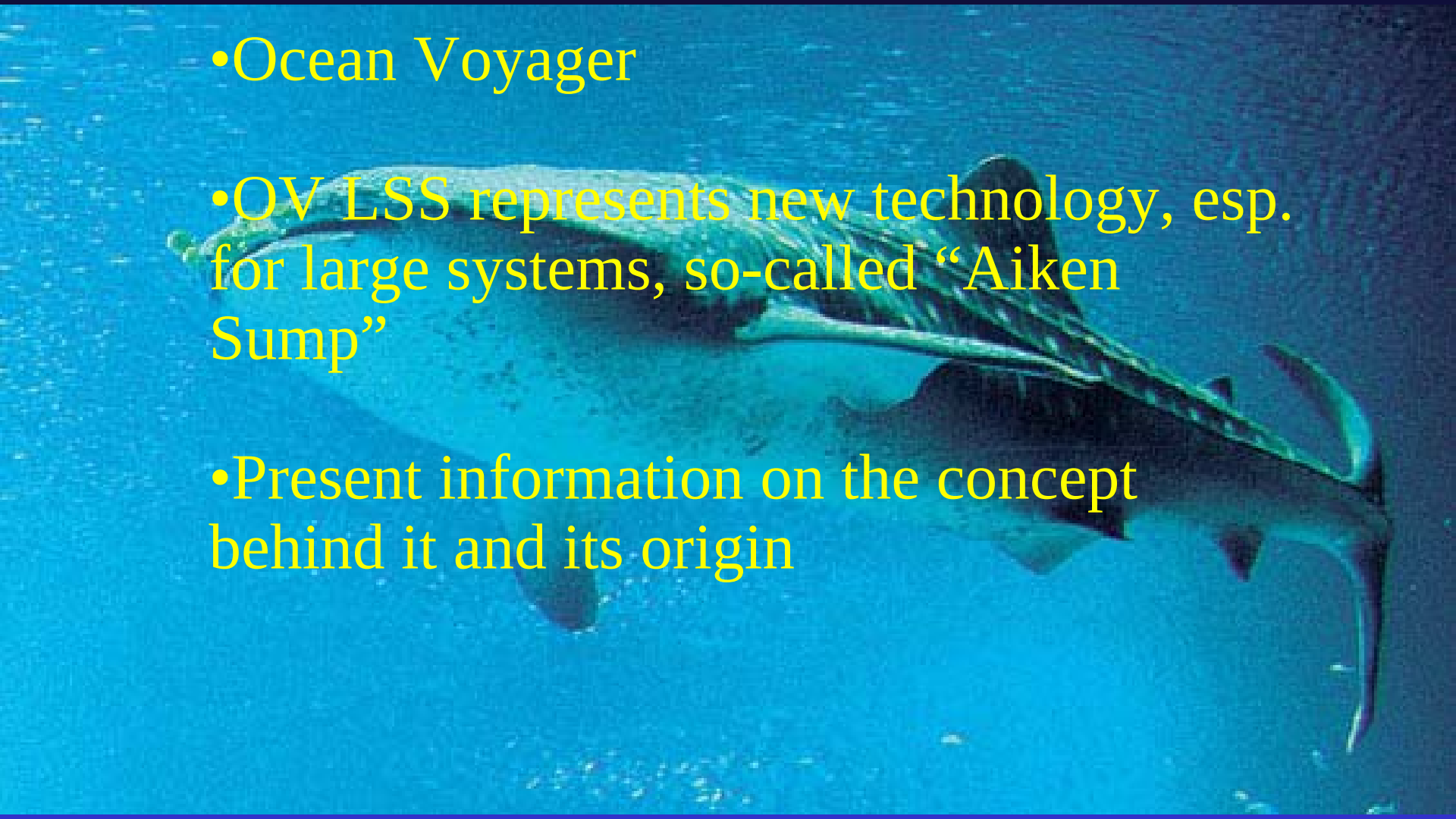
Andrew Aiken aaiken@aqua.org

Intro

- Ocean Voyager
- OV LSS represents new technology, esp. for large systems, so-called “Aiken Sump”

Andrew Aiken aaiken@aqua.org

Intro



- Ocean Voyager
- OV LSS represents new technology, esp. for large systems, so-called “Aiken Sump”
- Present information on the concept behind it and its origin

Andrew Aiken aaiken@aqua.org

Rio Negro

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

Amazon River Forest Exhibit
National Aquarium

Andrew Aiken aaiken@aqua.org

Rio Negro

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

Rio Solimoens

RIO NEGRO

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

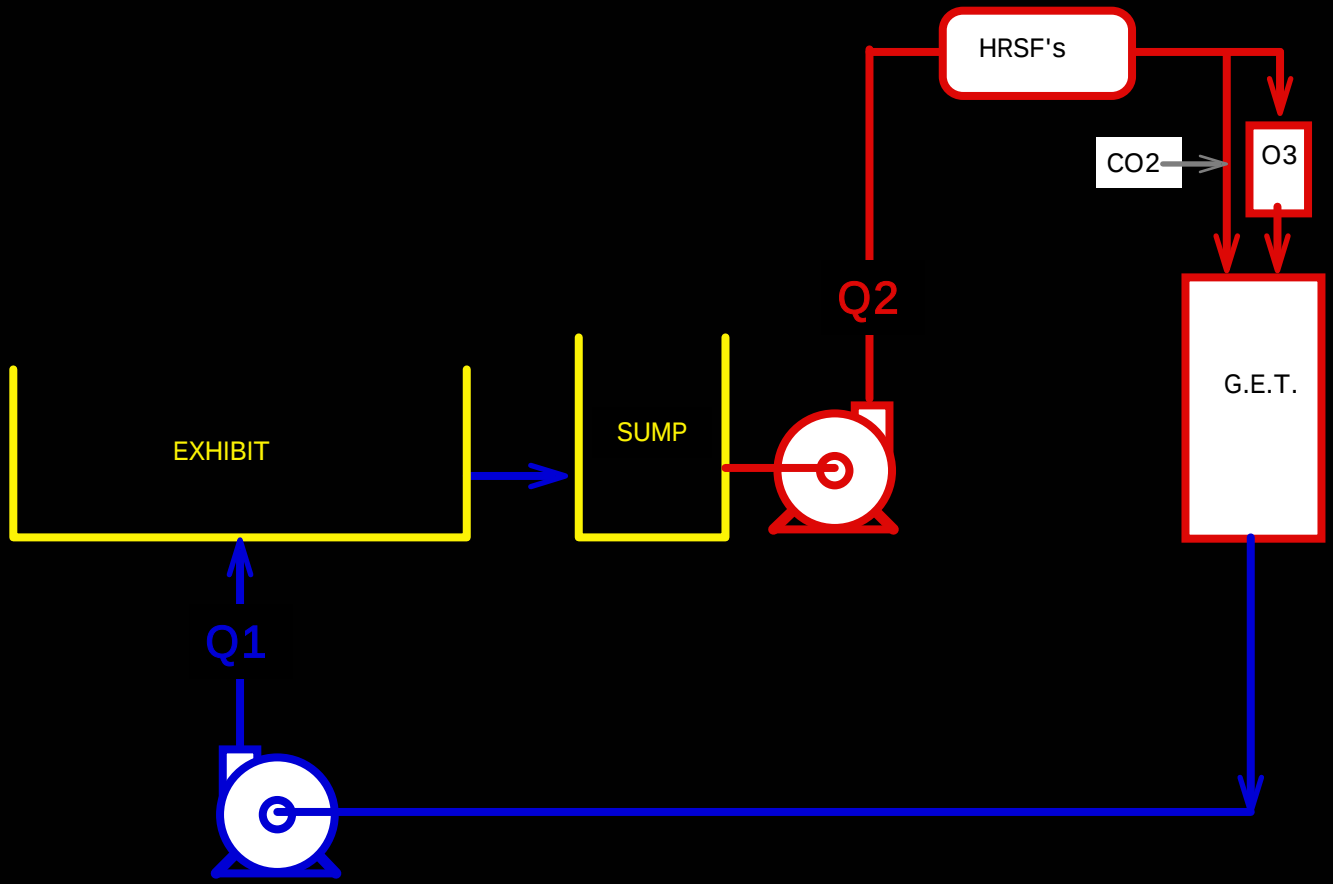
SOLIMOENS

Andrew Aiken aaiken@aqua.org

System Requirements

- Sump at start of process
  - -To add peat to provide dark, tea-colored water
  - -Also provides off-exhibit access to exhibit water
- HRSF - requires pump
- Gas Exchange Tower for CO_2 addition
  - water pressure is lost here
- Pressurized flow required at supply (per Exhibit Designer)

Andrew Aiken aaiken@aqua.org


HRSF's
CO2
O3
Q2
G.E.T.
EXHIBIT
SUMP
Q1

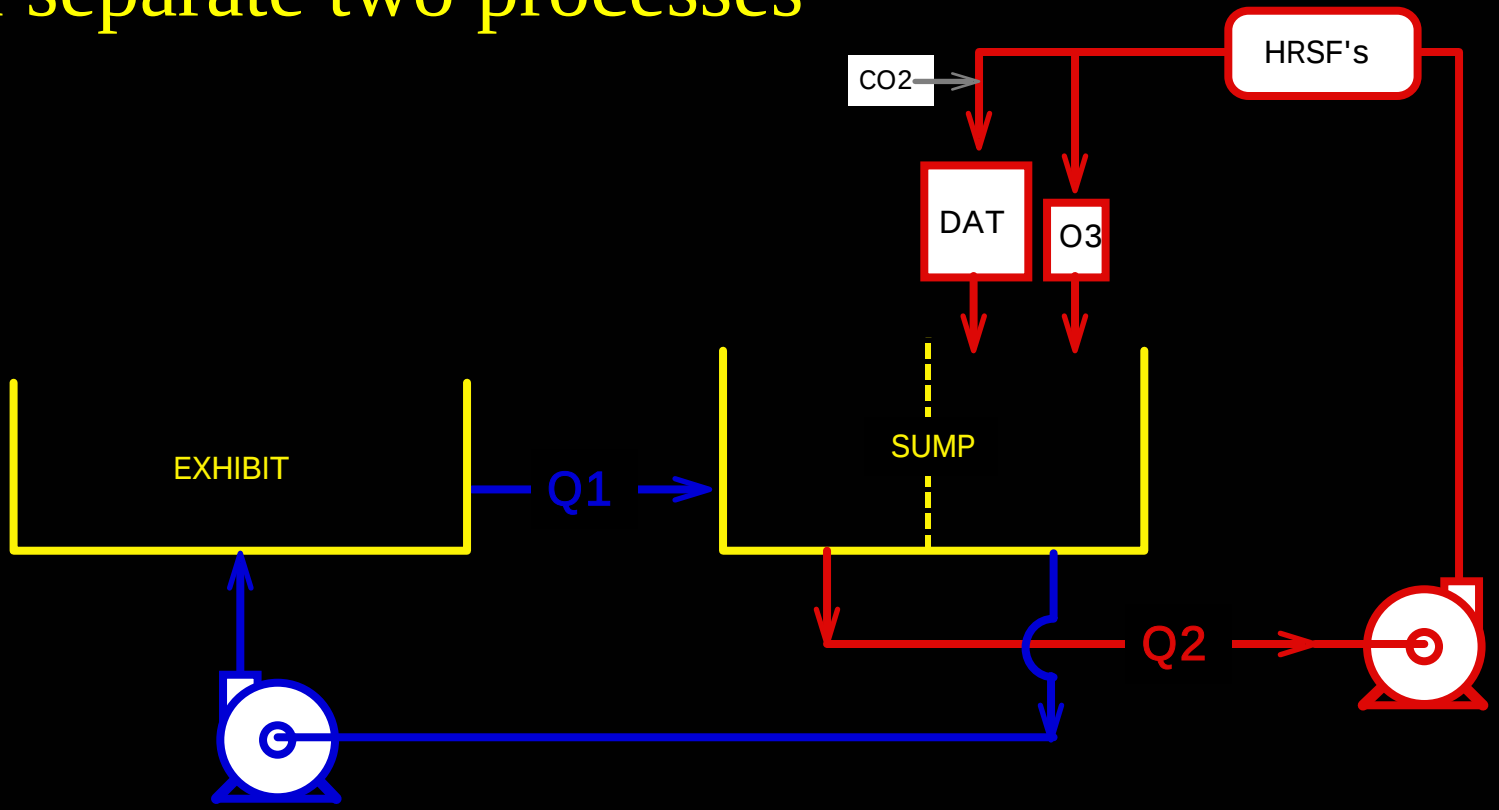
Regulate Pump Flows - Options

Option 1: Use level sensors, flow meters w/ 4-20mA output, VFD's on pumps to monitor and regulate flow via PLC

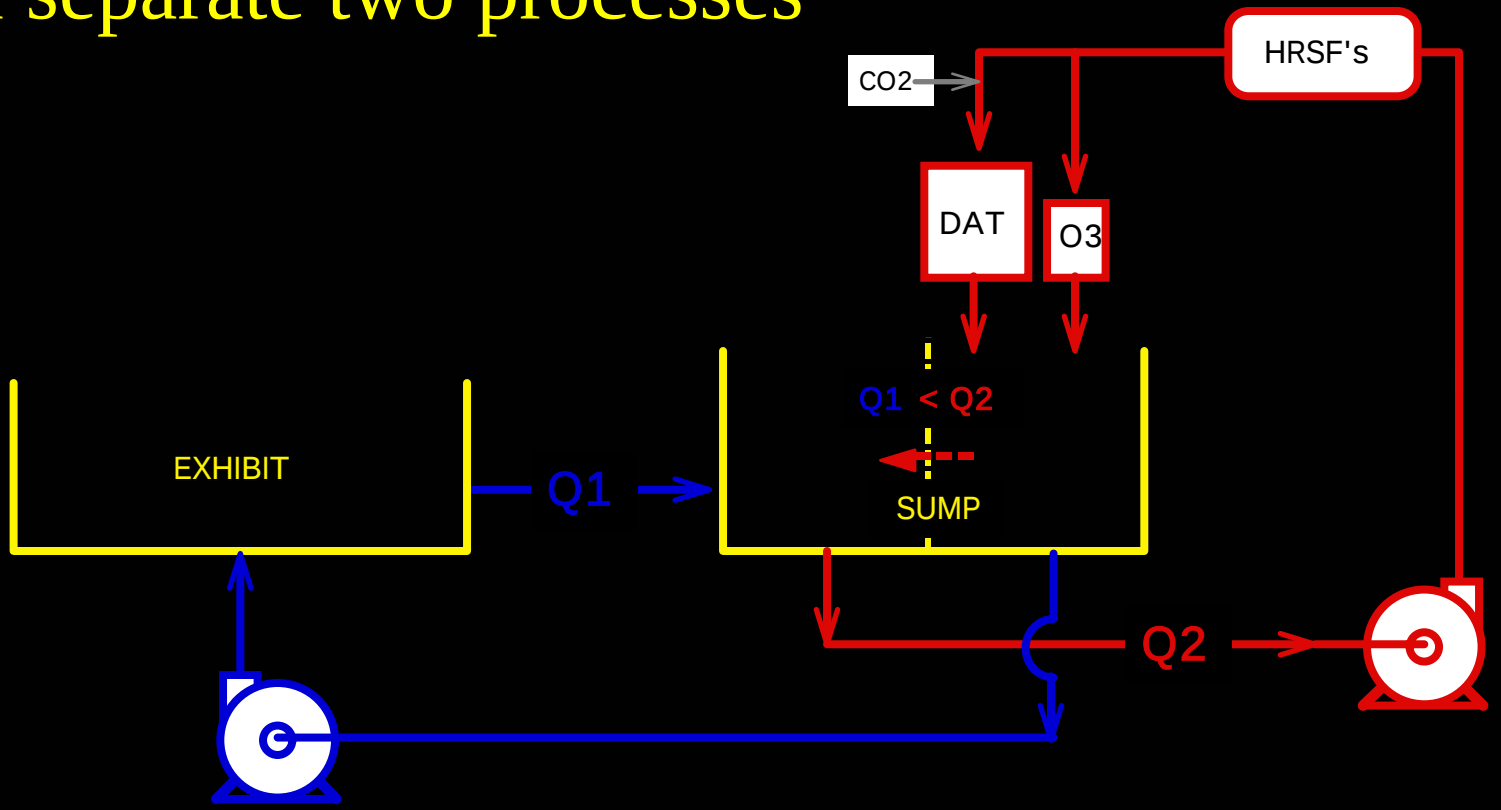
- Equipment $$
- Maintenance
- More points to alarm and track
- Potential for failure for each device and control link

Andrew Aiken aaiken@aqua.org

Option 2: Use common sump with baffle that allows *minimal* flow to pass thru but will separate two processes



Option 2: Use common sump with baffle that allows *minimal* flow to pass thru but will separate two processes



Benefits

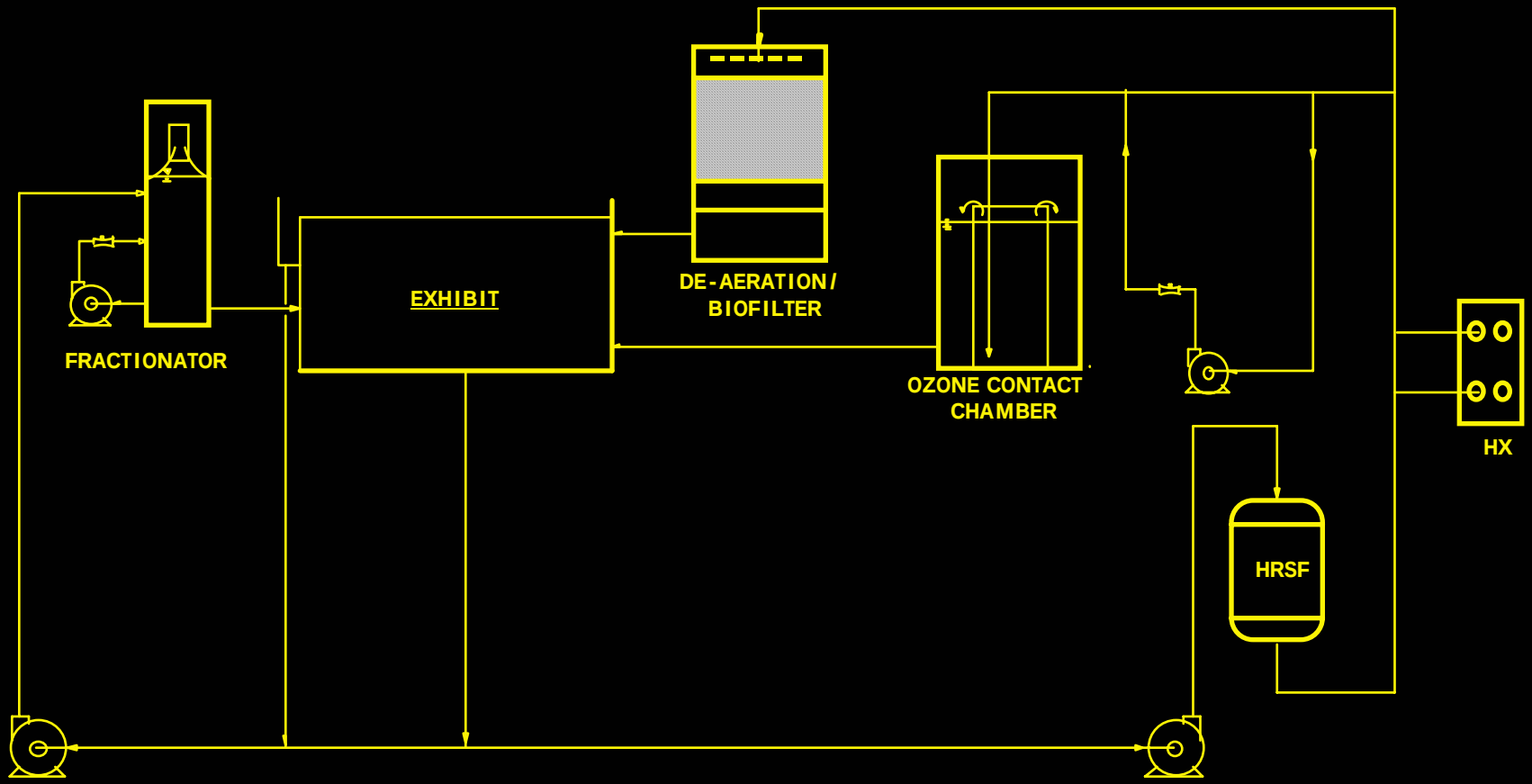
- Low cost
- Low Maintenance
- No points to alarm and track
- Uses gravity to control direction

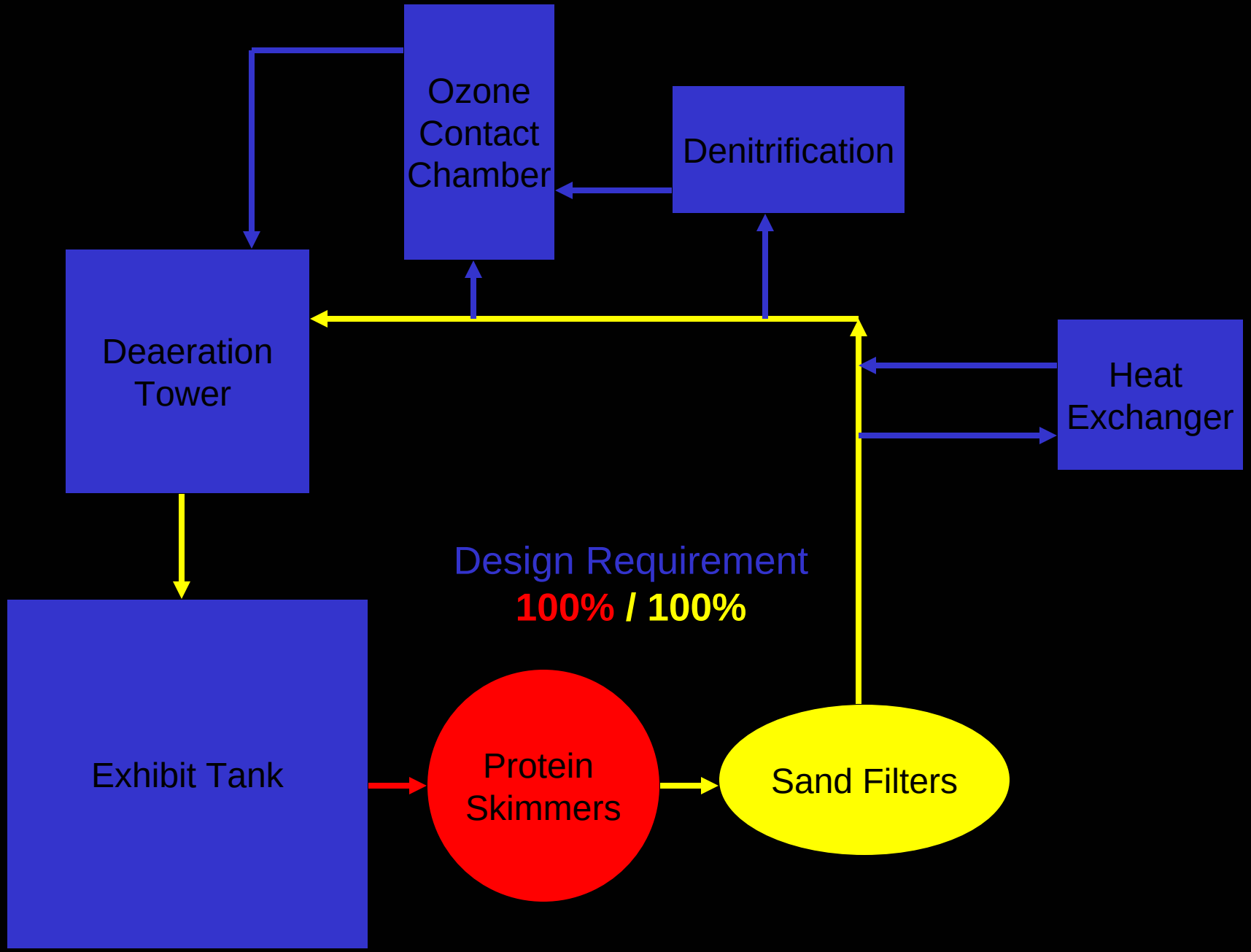
Andrew Aiken aaiken@aqua.org

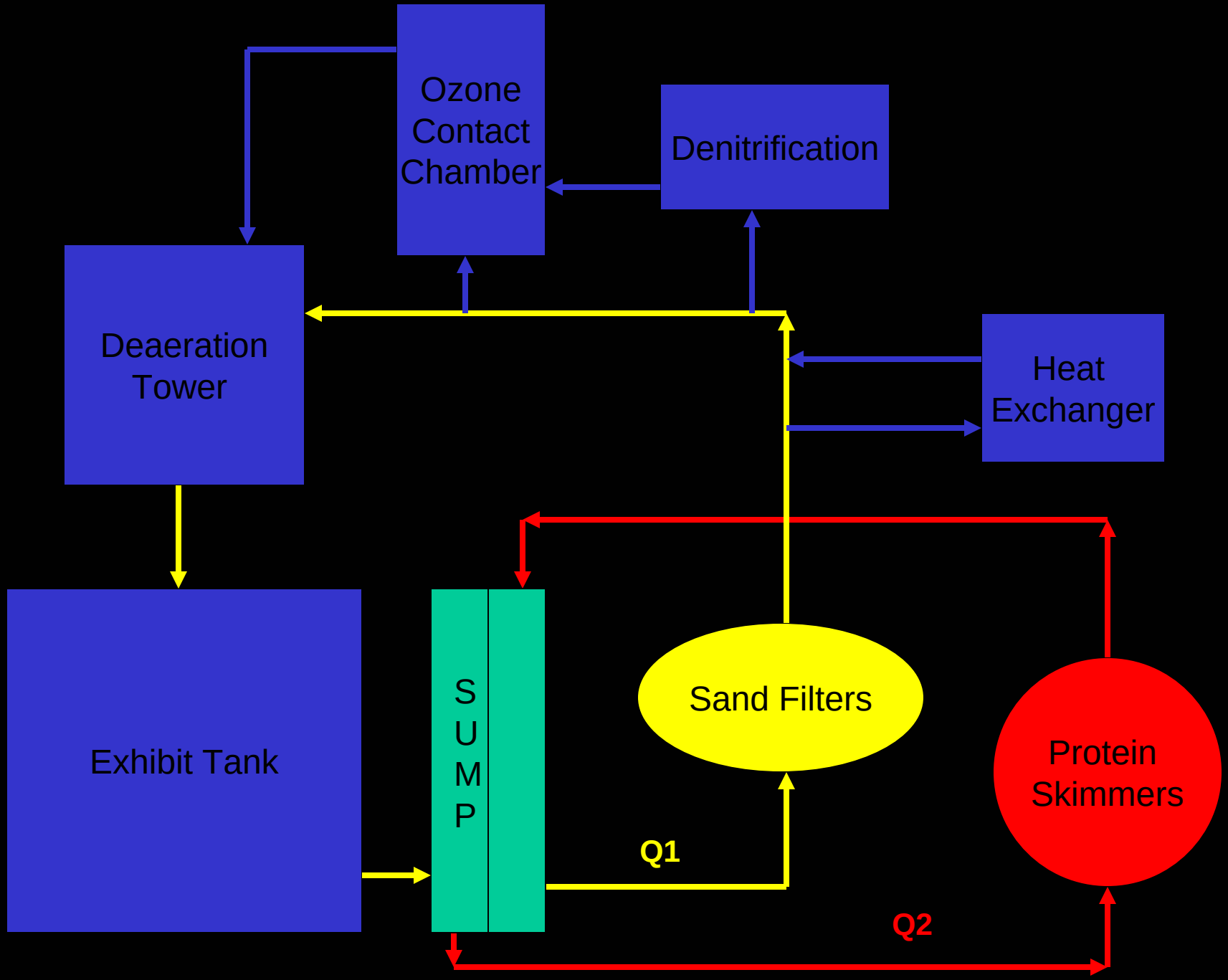
Scaling Up - GAI Ocean Voyager

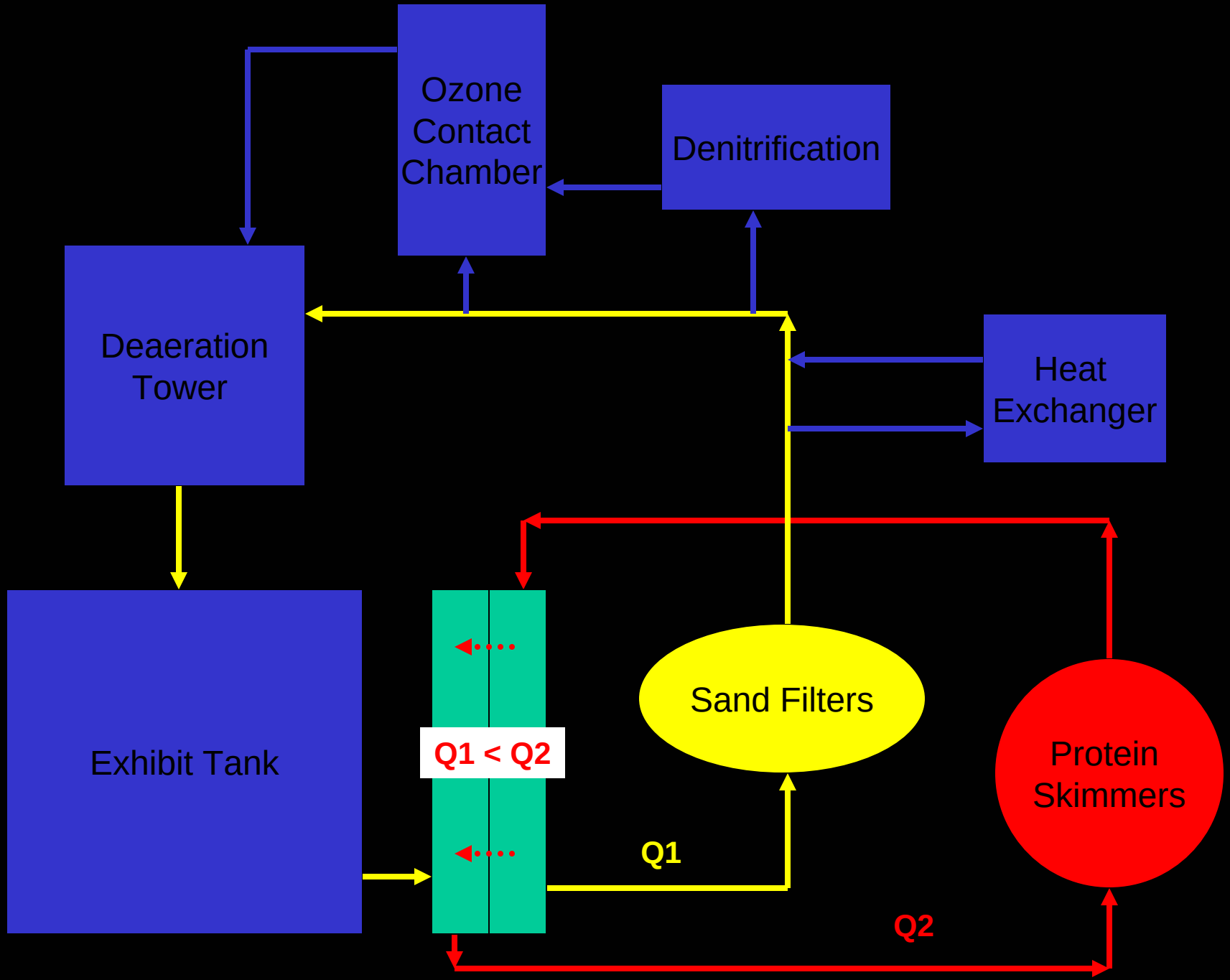
Scaling Up - GAI Ocean Voyager

- System requirements:
  - 100%/100% flow: each turnover to provide 100% fractionation and 100% sand filtration
  - Fracs 1st, SF 2nd
  - Pressure loss at fracs creates similar flow control issue


FRACTIONATOR
EXHIBIT
DE-AERATION/
BIOFILTER
OZONE CONTACT
CHAMBER
HRSF
HX


Ozone Contact Chamber
Denitrification
Deaeration Tower
Heat Exchanger
Design Requirement
100% / 100%
Exhibit Tank
Protein Skimmers
Sand Filters


Ozone Contact Chamber
Denitrification
Deaeration Tower
Heat Exchanger
Exhibit Tank
S U M P
Sand Filters
Protein Skimmers
Q1
Q2


Ozone Contact Chamber
Denitrification
Deaeration Tower
Heat Exchanger
Exhibit Tank
Q1 < Q2
Sand Filters
Protein Skimmers
Q1
Q2

GAI Ocean Voyager

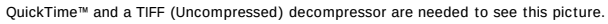
- Scaling up from 5,000 gallon sump to 450,000 gallon sump has its challenges
  - -force of 67,000 GPM had to be considered
  - -baffle has multiple holes
  - -linearization affected

Benefits

- Increase or decrease flow rate through fracs Without affecting flow rate through tank

- Control is maintained without level sensors, etc., and additional control points

- Construction of sump is extension of tank, significant cost savings achieved


QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.