Visualizing Mars: Enabling STEM learning using Revit, Autodesk LIVE, and Stingray

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Architects, KieranTimberlake
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@KIERANTMBERLK

Class summary

STEM & Mars City

- Leveraging VR in Design

The Path to VR: Methods and Workflows

Key learning objectives

At the end of this class, you will be able to:

- Demonstrate how virtual reality can enhance STEM education programs
- Understand the applicability of real-time information within a VR environment
- Describe how virtual reality visualization can be used during the design process using Revit, Autodesk LIVE, and Stingray
- Harness the power of live design optioning visualization within immersive environments

STEM and Mars City

KIERANTIMBERLAKE

National Institute of BUILDING SCIENCES

Total Learning Research Institute

NASA

Gilbane

alderson /engineering

IFMA™ International Facility Management Association Empowering Facility Professionals Worldwide

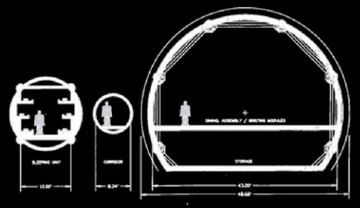
TMASYSTEMS

AUTODESK.

MARS CITY is a program of the Total Learning Research Institute. It is designed to provide team-based science and engineering challenges for students along with STEM career guidance. Inquiries about the program should be directed to the Institute at tlrimail@gmail.com.

INITIAL DESIGN

TLRI partners with architect Richard John Gabriel to design the base design for Mars City.



1997

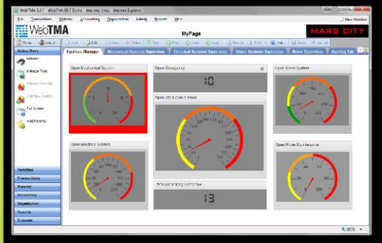
STEM PROGRAM

2011

In late 2011, the National Institute of Building Sciences (NIBS) teamed up with the Total Learning Research Institute (TLRI) and the National Aeronautics and Space Administration (NASA) to establish a science, technology, engineering and mathematics (STEM) education program

DASHBOARD

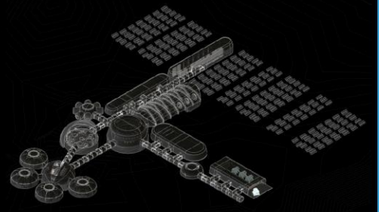
Development of Web TMA Dashboard for Mars Facility Ops Challenge by NIBS & TLRI



2012

BIM MODEL

2014



As part of KieranTimberlake's community involvement initiative, a team of architects and researchers joing the Mars Facility Ops Challenge project. The team collaborates with Gilbane Construction & Alderon Engineering to develop BIM model.

SCENARIOS

Facility managers from the International Facility Management Association (IFMA) and NIBS' Facility Maintenance and Operations Committee (FMOC) develop the scenarios and professional solutions to be presented to students.

2015

BASE VR MODEL

2015

KieranTimberlake takes BIM model and begins work on a virtual reality model for Mars City

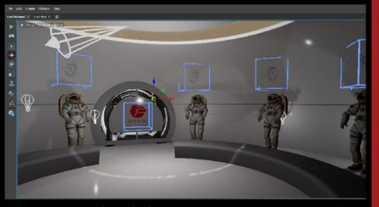
VR MODEL TESTING

KieranTimberlake, NIBS & TLRI test VR model at the US Science & Engineering Festival in Washington DC. Over 1,000 students use the Mars City model.

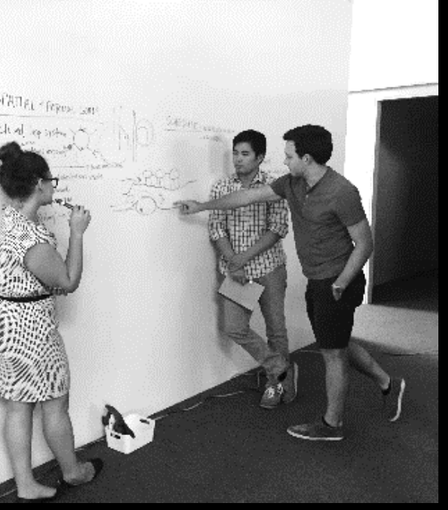
2016

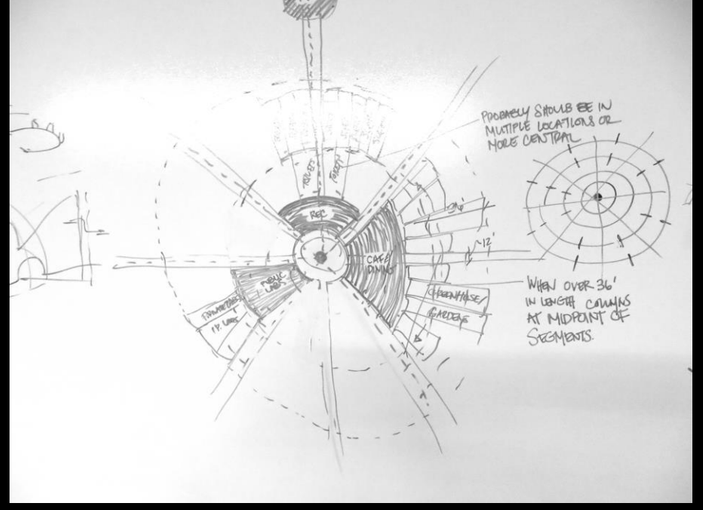
AU 2016

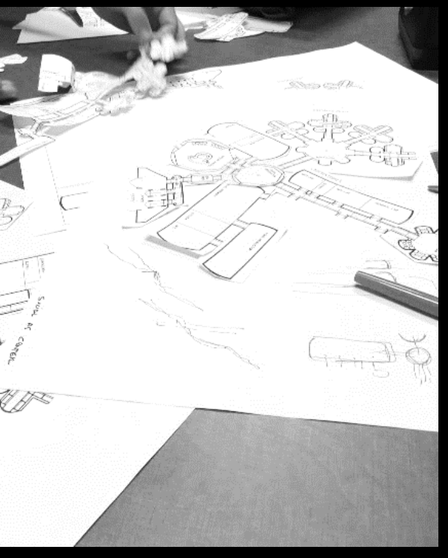
2016

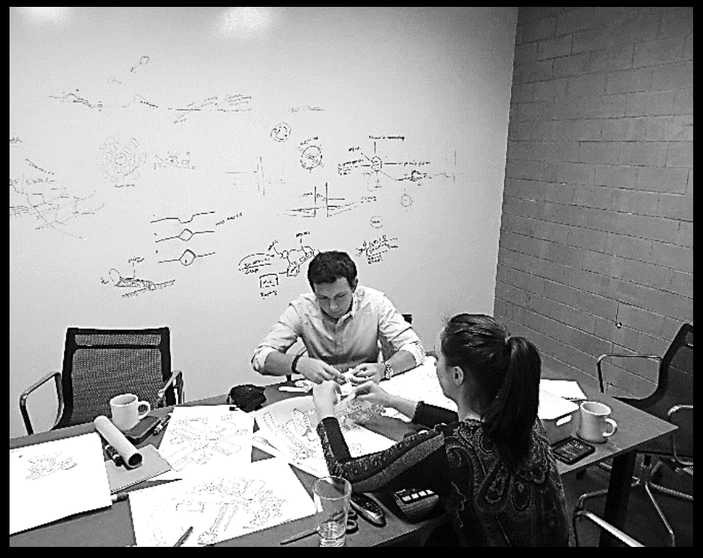


KieranTimberlake integrates interactivity and scenarios into the virtual reality environment using Revit, Autodesk LIVE and Stingray




PROBABLY SHOULD BE IN MULTIPLE LOCATIONS OR MORE CENTRAL
WHEN OVER 36' IN LENGTH COLUMN AT MIDPOINT OF SEGMENTS






YOUR ADVENTURE BEGINS NOW
MARS CITY
BOOK YOUR TOUR TODAY


MARS CITY
BOOK YOUR TOUR TODAY
TMA SYSTEMS
MISSION CONTROL
MEET YOUR TEAM HERE
MARS CITY CREW


CITY
CLUSTER
VR ROOMS
FOOD & HEALTH

SMALL

Schematic Design | Design Development

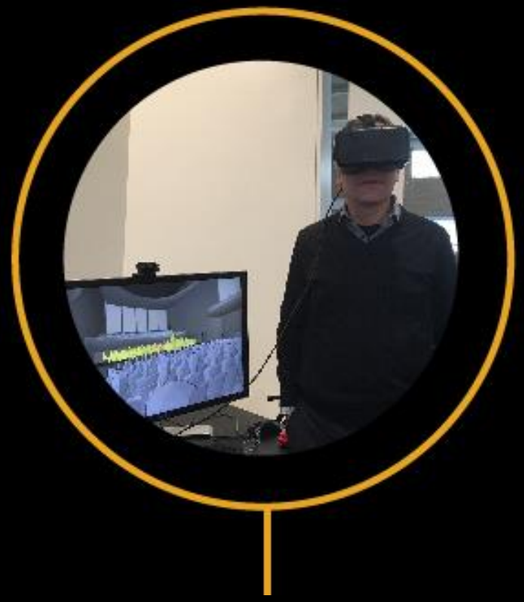
WASHINGTON UNIVERSITY WEIL HALL

Iterative Workflow
Autodesk LIVE

Consultant coordination
Client presentations
Design iteration

MEDIUM

Programming | Design Development



NEW YORK UNIVERSITY 181 MERCER

Benchmark Workflow
Unity

Consultant coordination
Design iteration

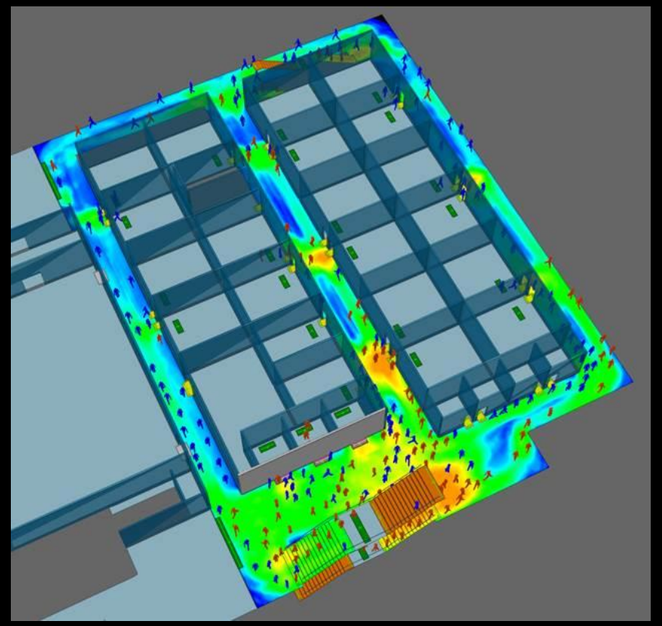
LARGE

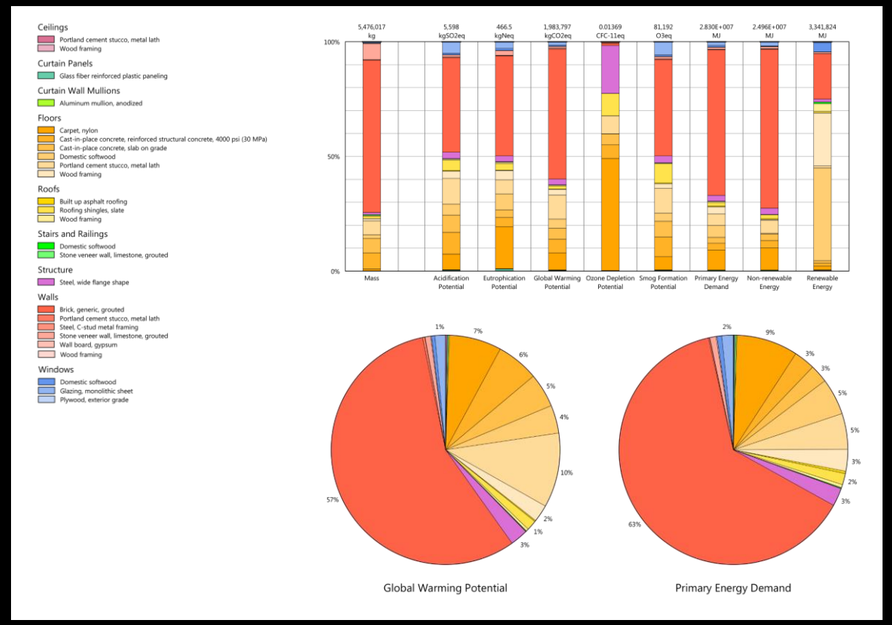
Final Design

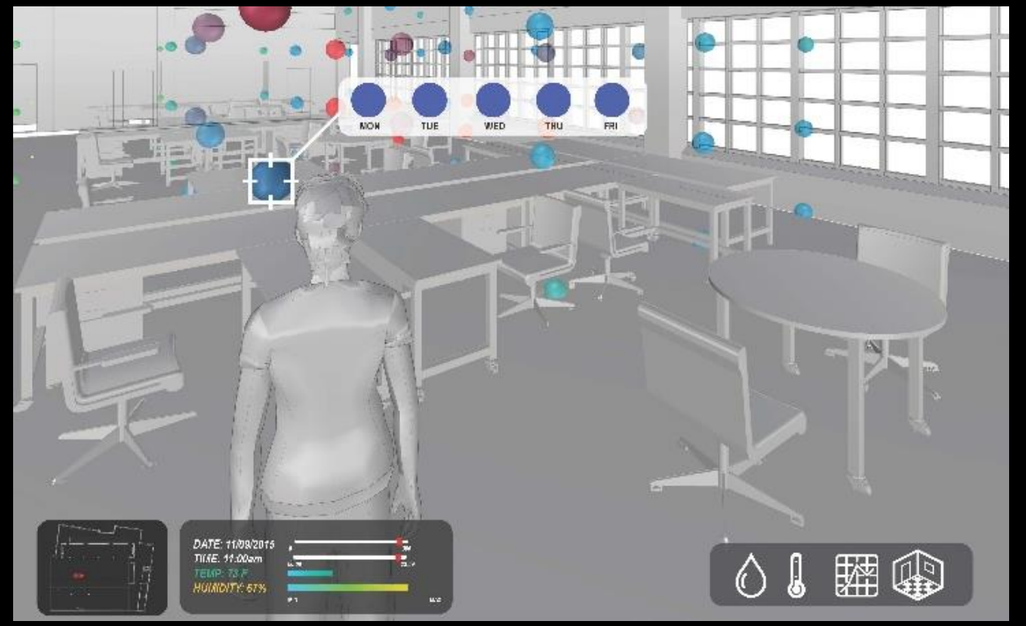
MARS CITY

Integrated Workflow
Autodesk LIVE

Final design
Refined for user interaction

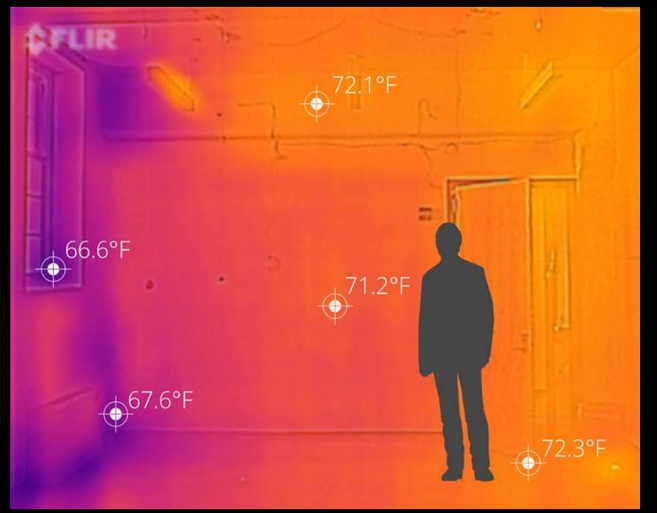


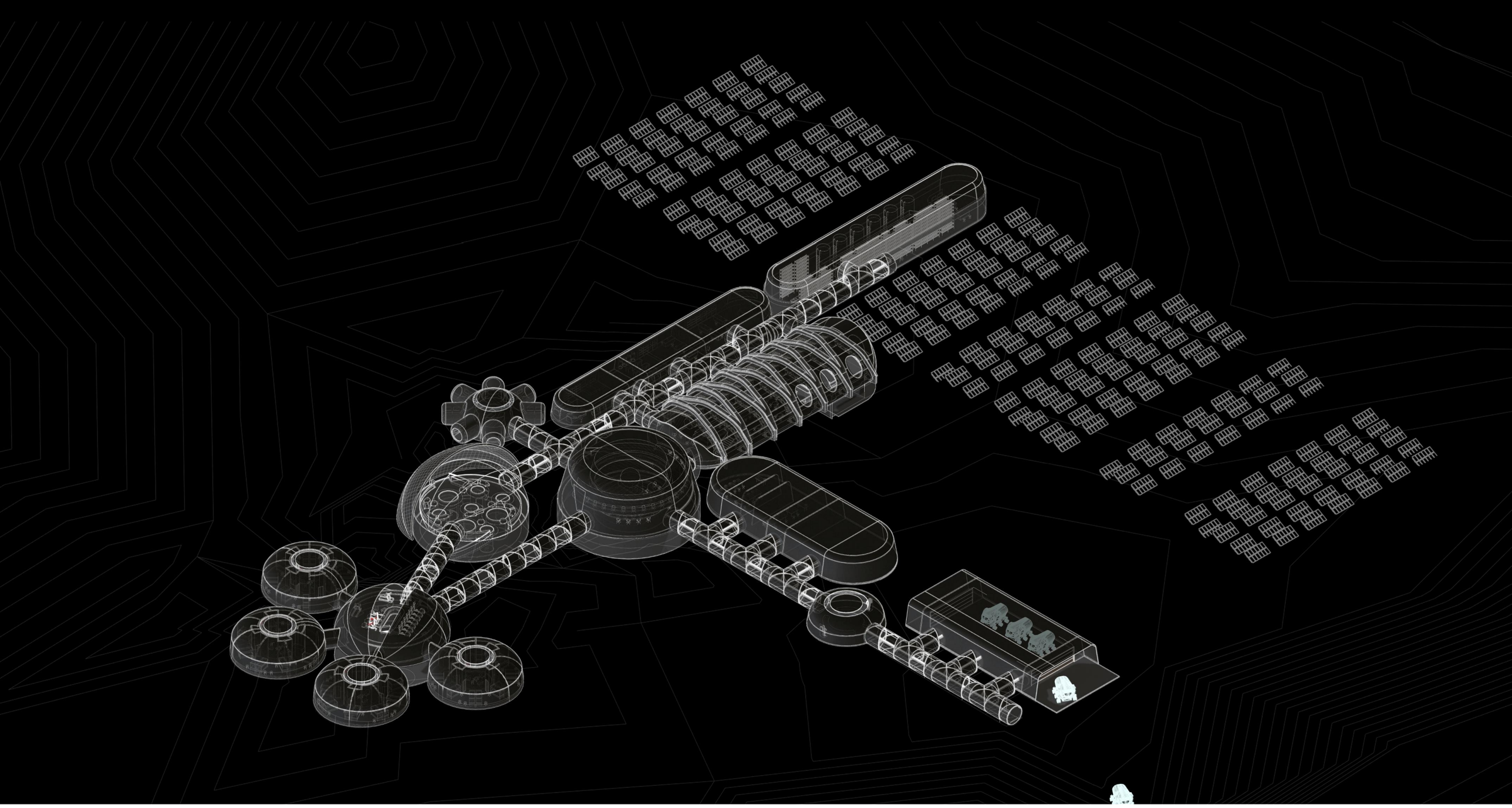

Ceilings
Portland cement stucco, metal lath
Wood framing
Curtain Panels
Glass fiber reinforced plastic paneling
Curtain Wall Mullions
Aluminum mullion, anodized
Floors
Carpet, nylon
Cast-in-place concrete, reinforced structural concrete, 4000 psi (30 MPa)
Cast-in-place concrete, slab on grade
Domestic softwood
Portland cement stucco, metal lath
Wood framing
Roofs
Built up asphalt roofing
Roofing shingles, slate
Wood framing
Stairs and Railings
Domestic softwood
Stone veneer wall, limestone, grouted
Structure
Steel, wide flange shape
Walls
Brick, generic, grouted
Portland cement stucco, metal lath
Steel, C-stud metal framing
Stone veneer wall, limestone, grouted
Wall board, gypsum
Wood framing
Windows
Domestic softwood
Glazing, monolithic sheet
Plywood, exterior grade
5,476,017 kg
5,598 kgSO2eq
466.5 kgNeq
1,983,797 kgCO2eq
0.01369 CFC-11eq
81,192 O3eq
2.830E+007 MJ
2.496E+007 MJ
3,341,824 MJ
100%
50%
0%
Mass
Acidification Potential
Eutrophication Potential
Global Warming Potential
Ozone Depletion Potential
Smog Formation Potential
Primary Energy Demand
Non-renewable Energy
Renewable Energy
1%
7%
6%
5%
4%
10%
2%
1%
3%
57%
Global Warming Potential
2%
9%
3%
3%
5%
5%
3%
2%
3%
63%
Primary Energy Demand

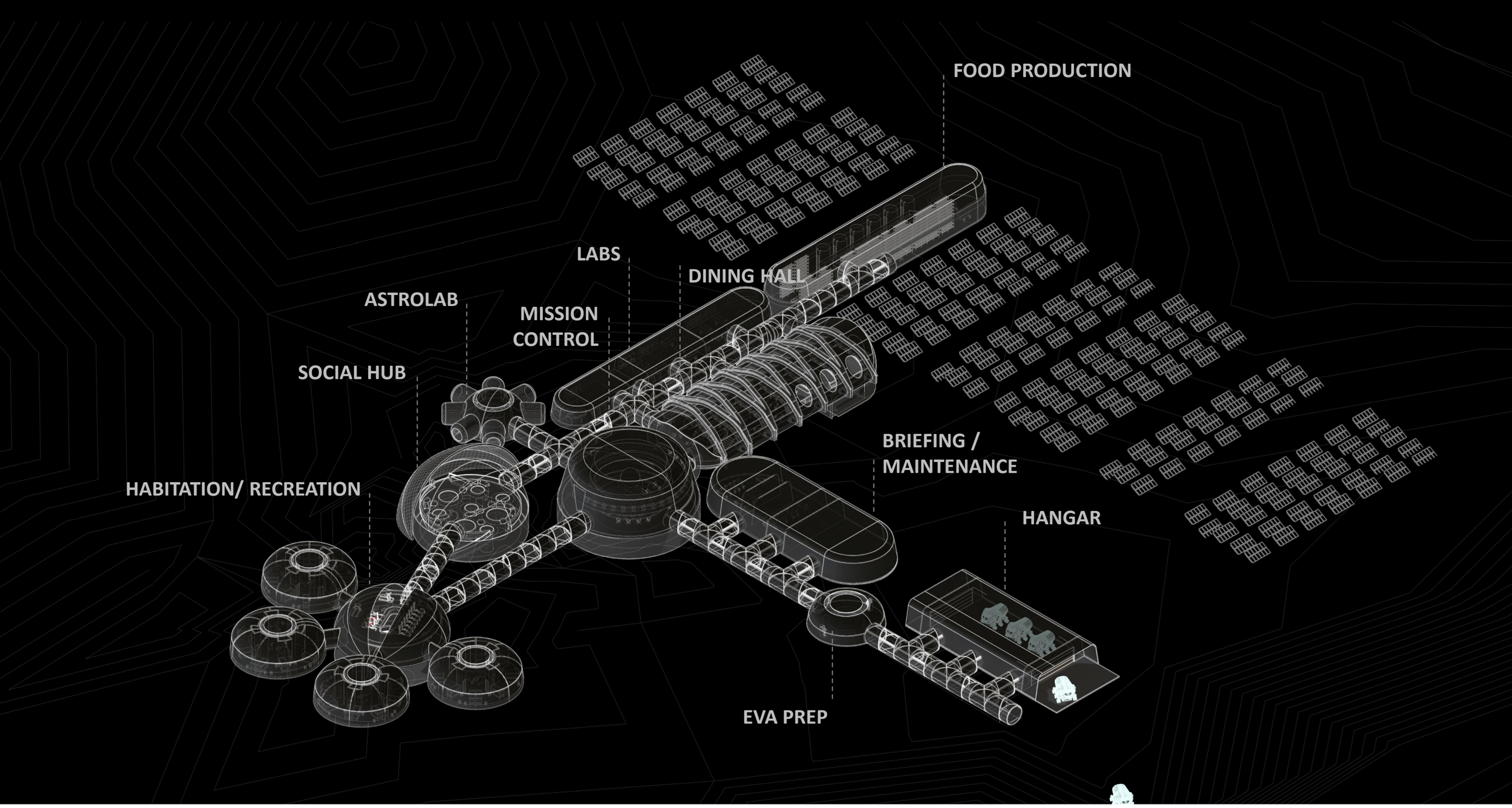

MON
TUE
WED
THU
FRI
DATE: 11/08/2015
TIME: 11:00am
TEMP: 73 F
HUMIDITY: 67%

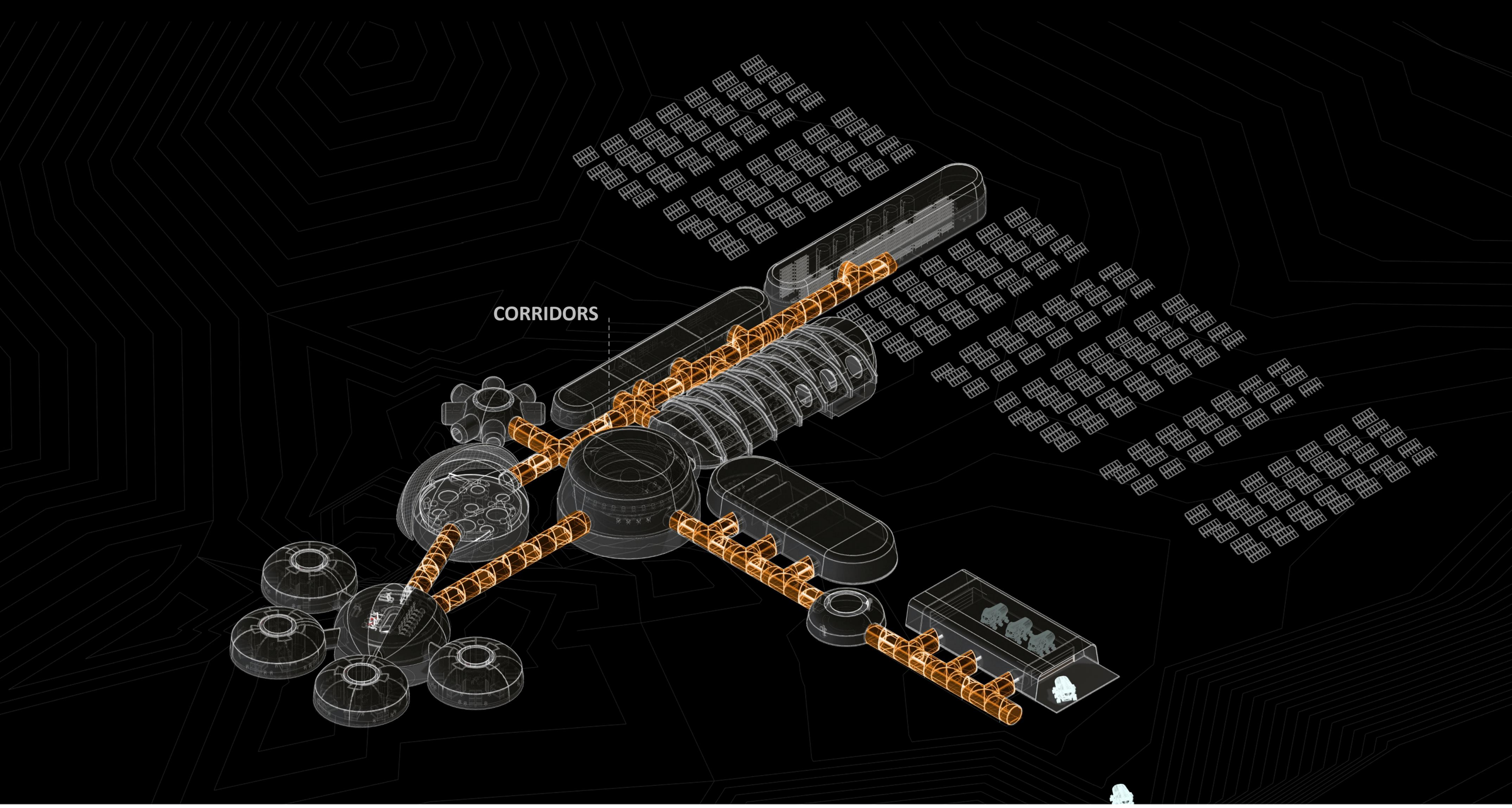

CONTENTS
POINTELIST
A guide to installing your sensor kit

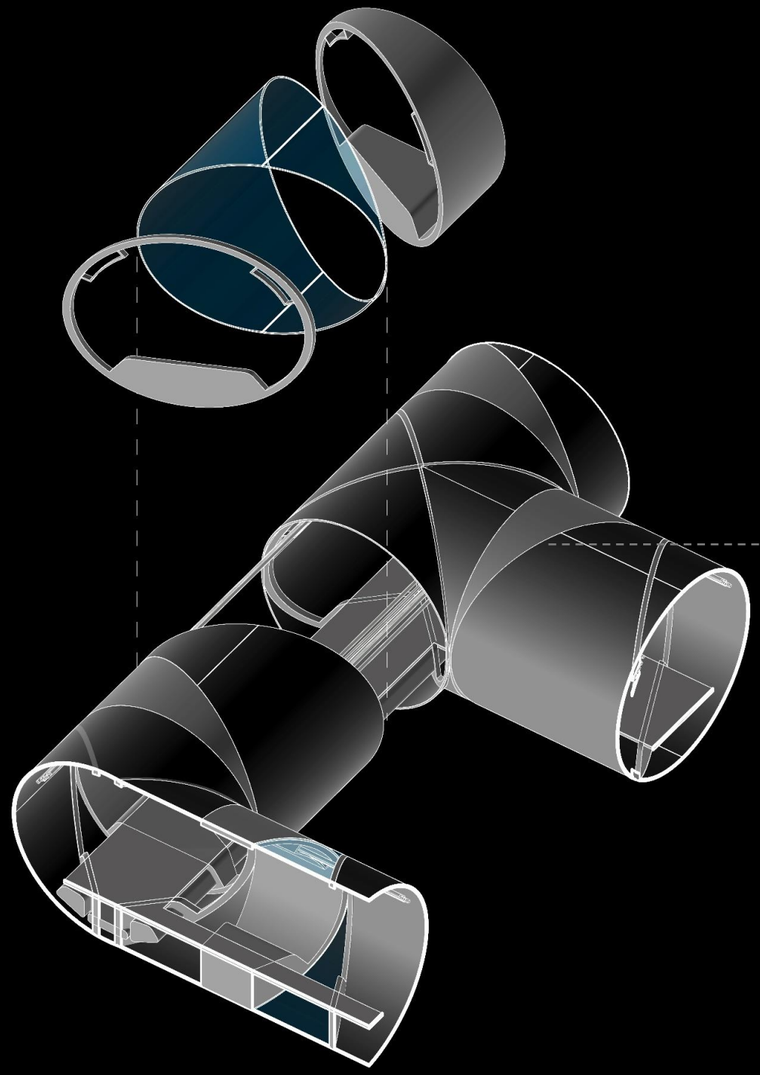

CMU WALL
DATE: 11/08/2015
TIME: 11:00am
TEMP: 73 F
HUMIDITY: 67%

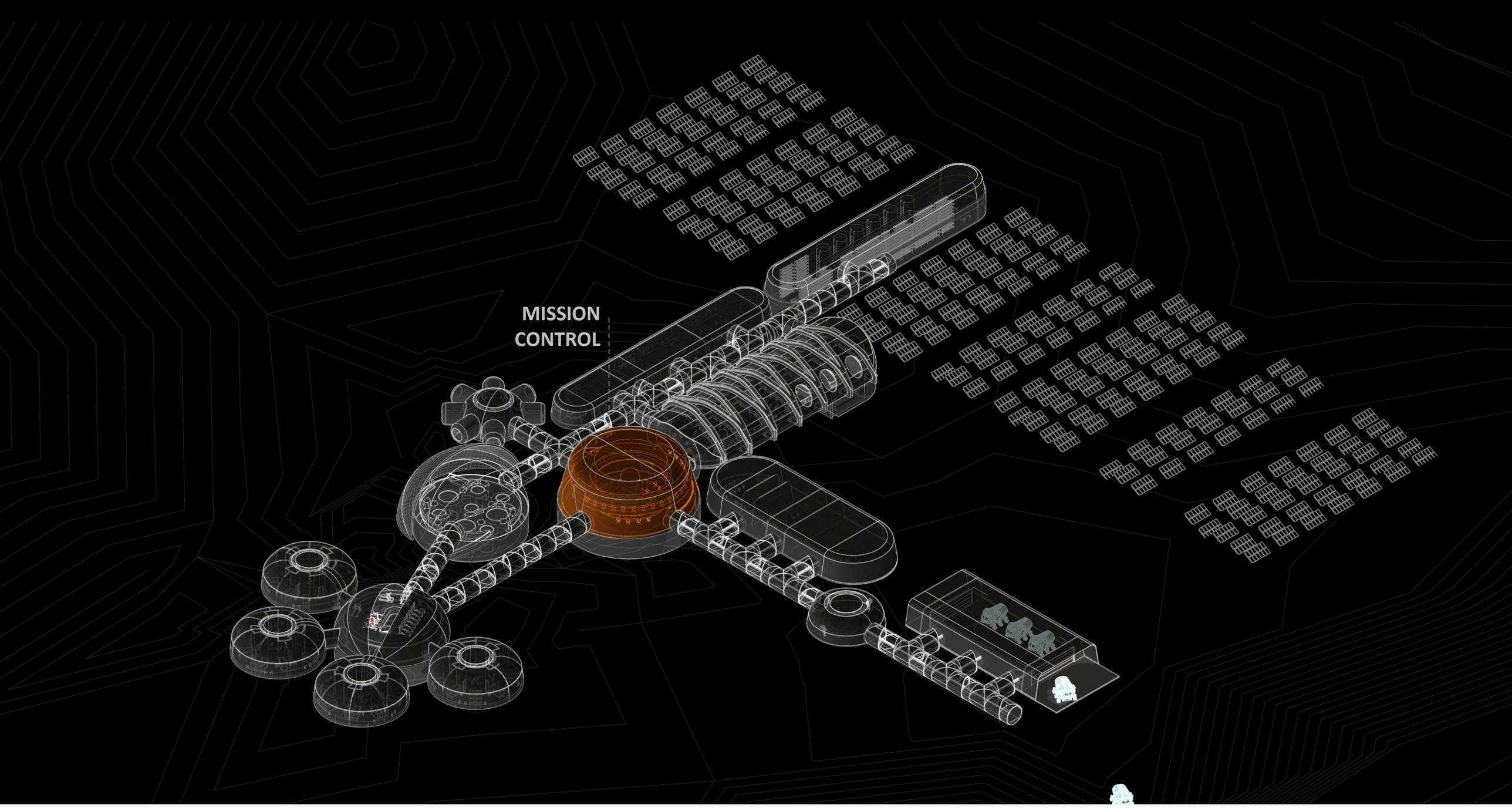

FLIR
72.1°F
66.6°F
71.2°F
67.6°F
72.3°F



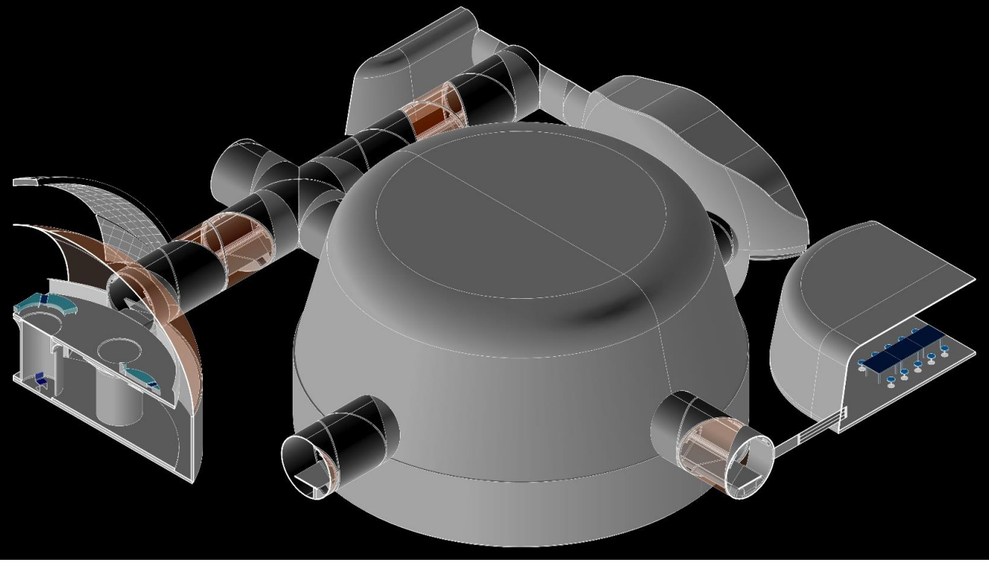

FOOD PRODUCTION
LABS
DINING HALL
ASTROLAB
MISSION CONTROL
SOCIAL HUB
BRIEFING / MAINTENANCE
HABITATION/ RECREATION
HANGAR
EVA PREP

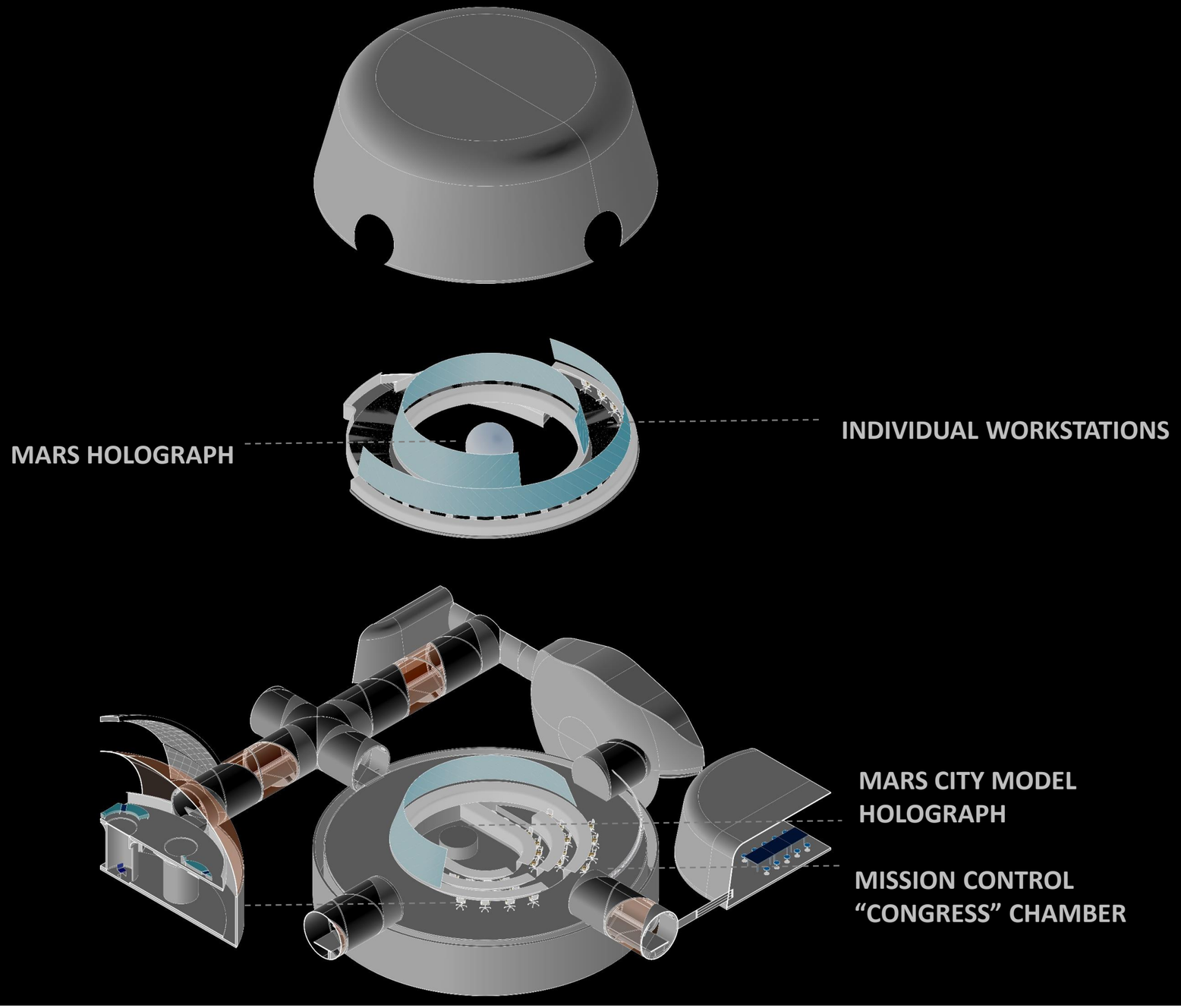

CORRIDORS

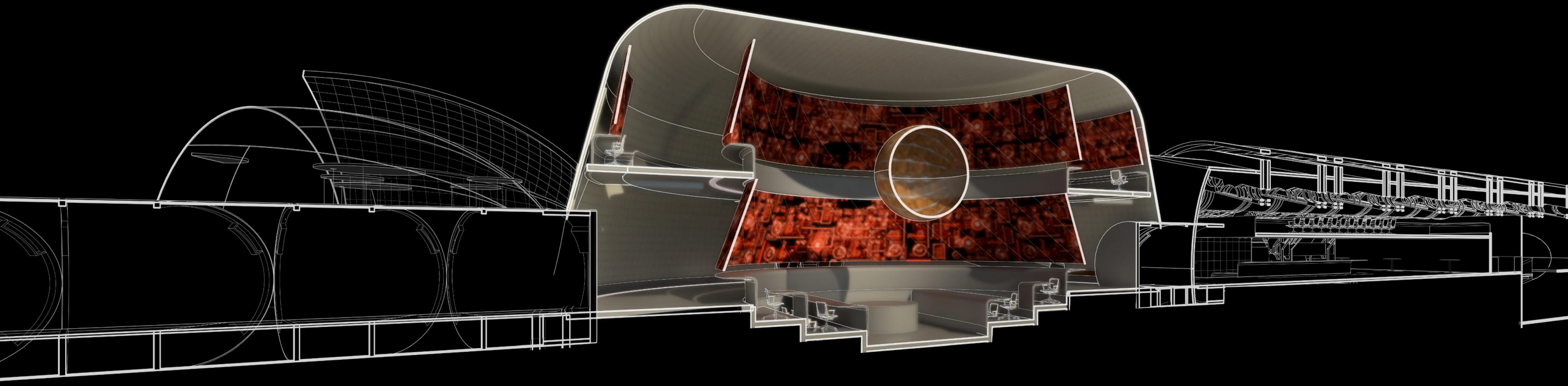



MISSION
CONTROL

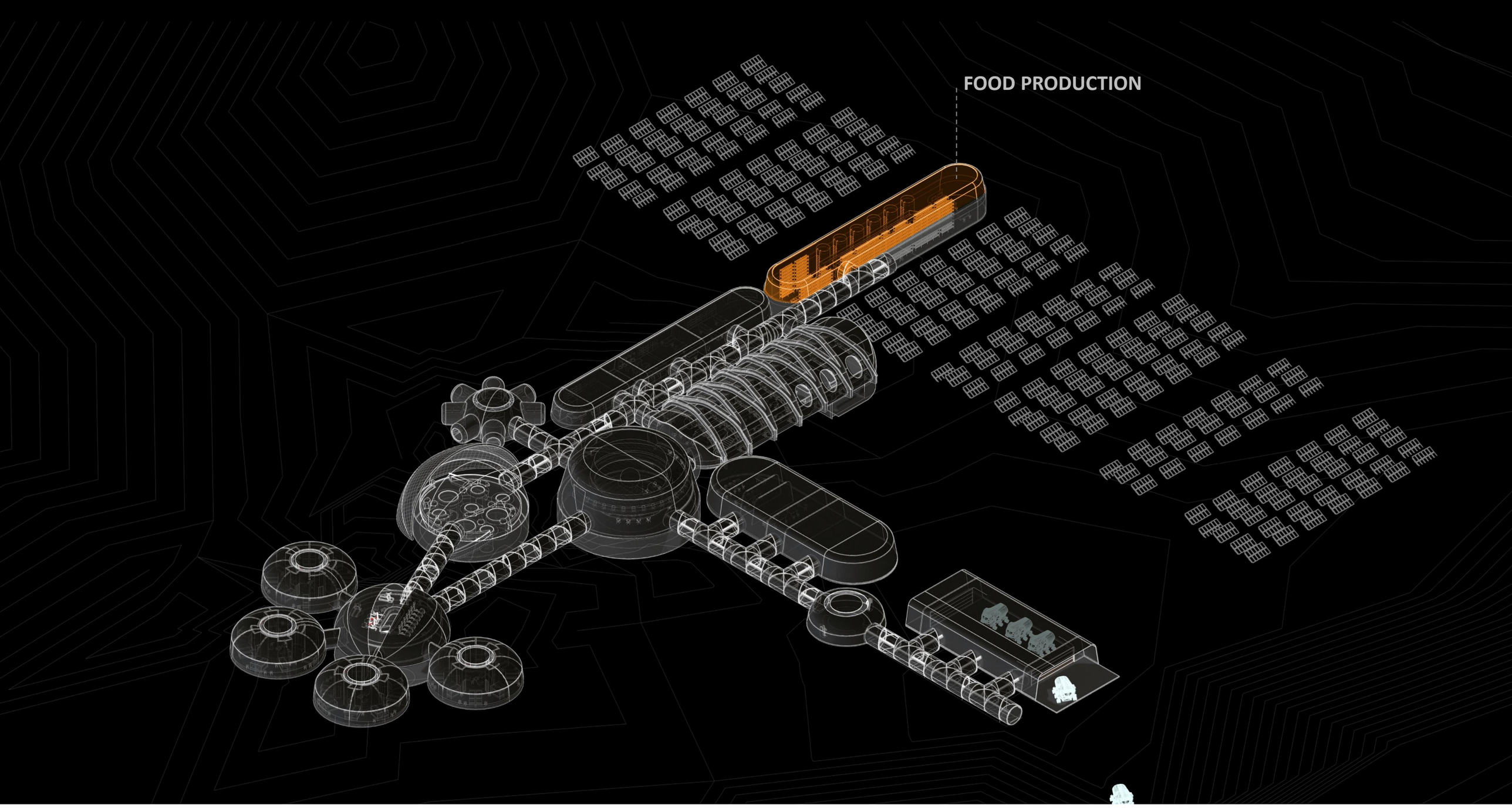
MISSION SUPPORT + ENVIRONMENTAL MONITORING + EARTH-MARS COMMUNICATIONS + BUILDING OPERATIONS =

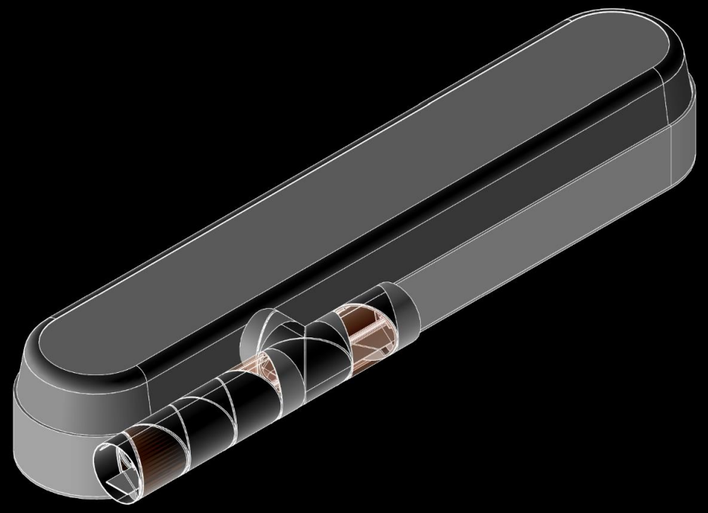


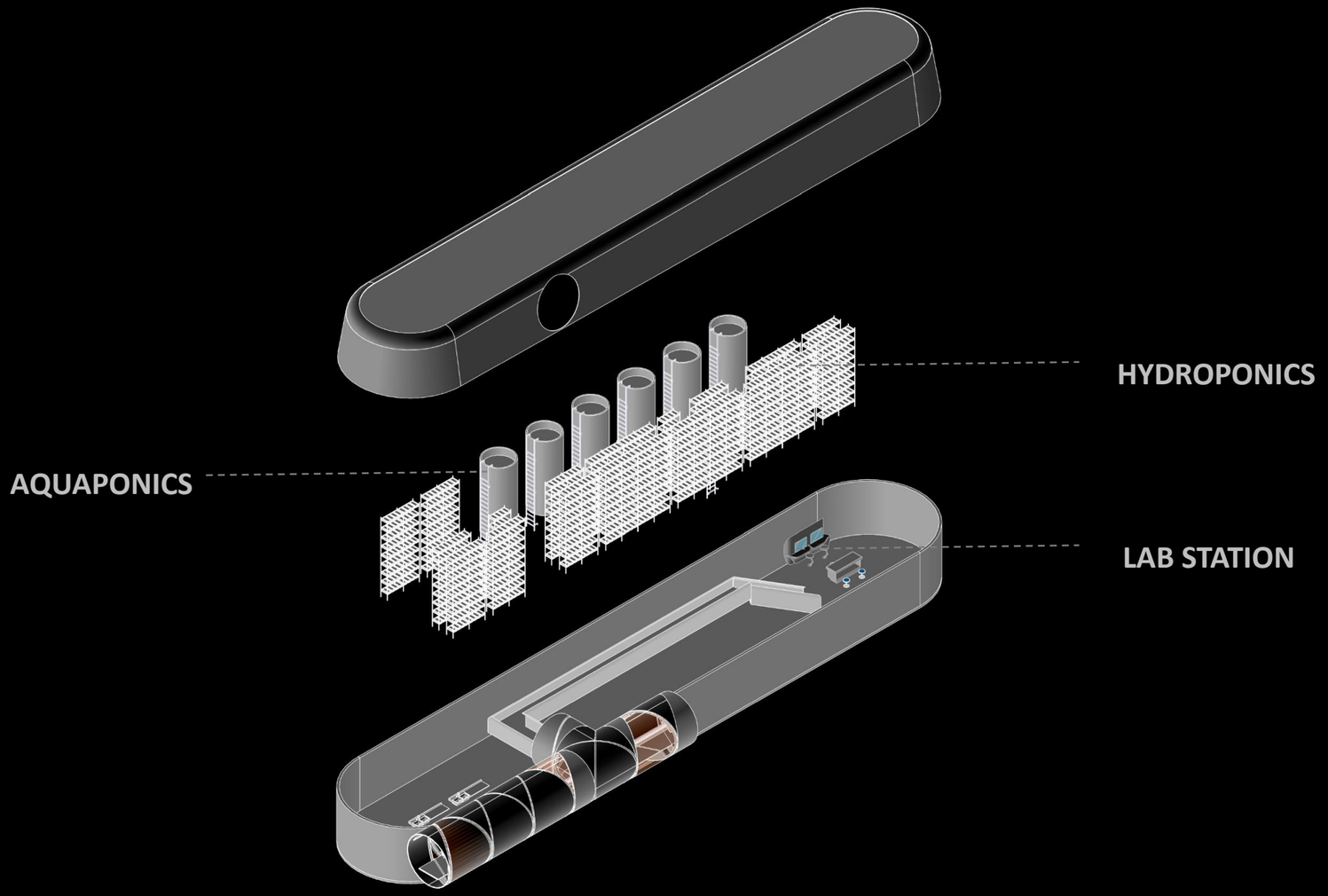

MARS HOLOGRAPH
INDIVIDUAL WORKSTATIONS
MARS CITY MODEL HOLOGRAPH
MISSION CONTROL "CONGRESS" CHAMBER

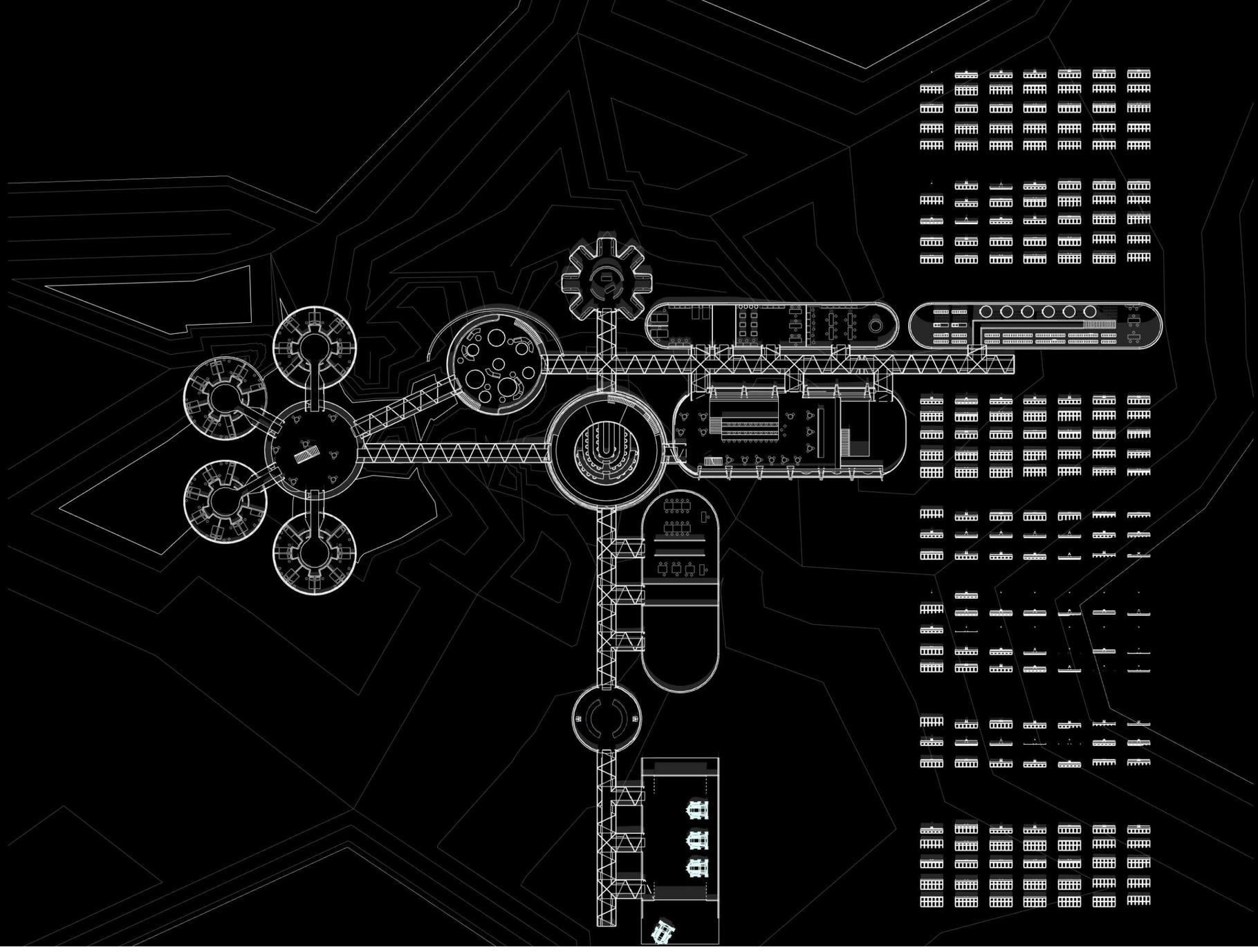



MARS CITY
MISSION CONTROL
FACILITIE
OPEN EMERGENCY
10
PM'S GENERATING TOMORROW
13
PMS CLOSED THIS MONTH: 1304
PMS CLOSED LAST WEEK: 4020
WOS CLOSED LAST WEEK: 0
112
160
156
38
194
147
172





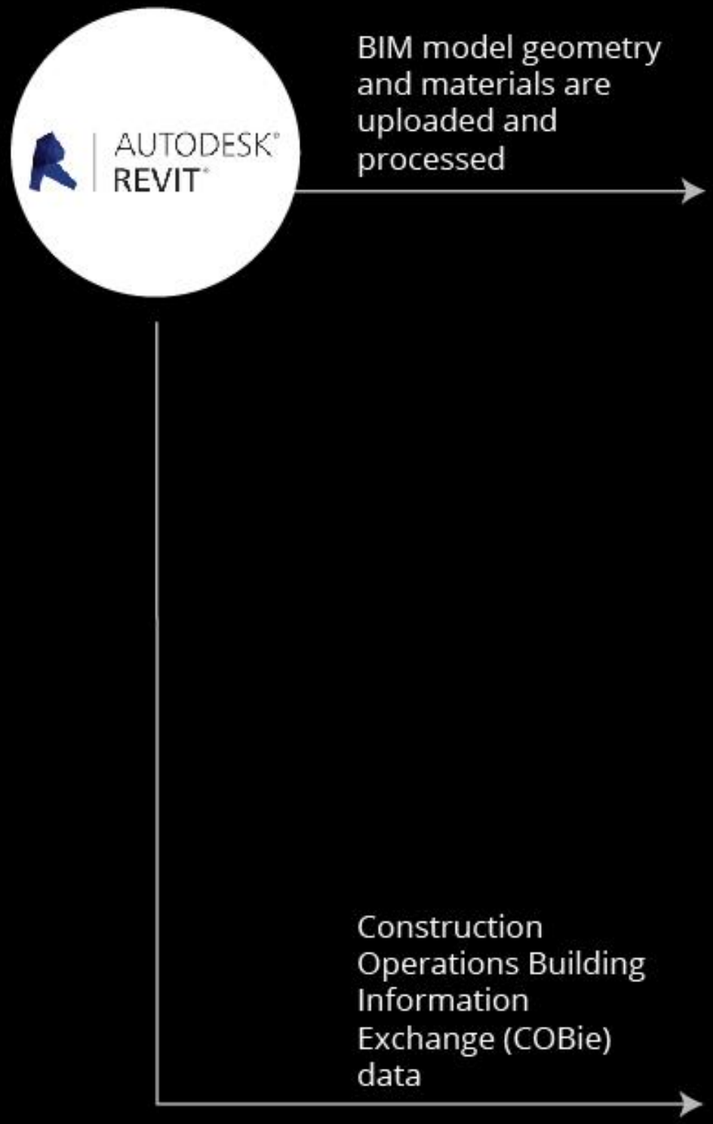

HYDROPONICS
AQUAPONICS
LAB STATION

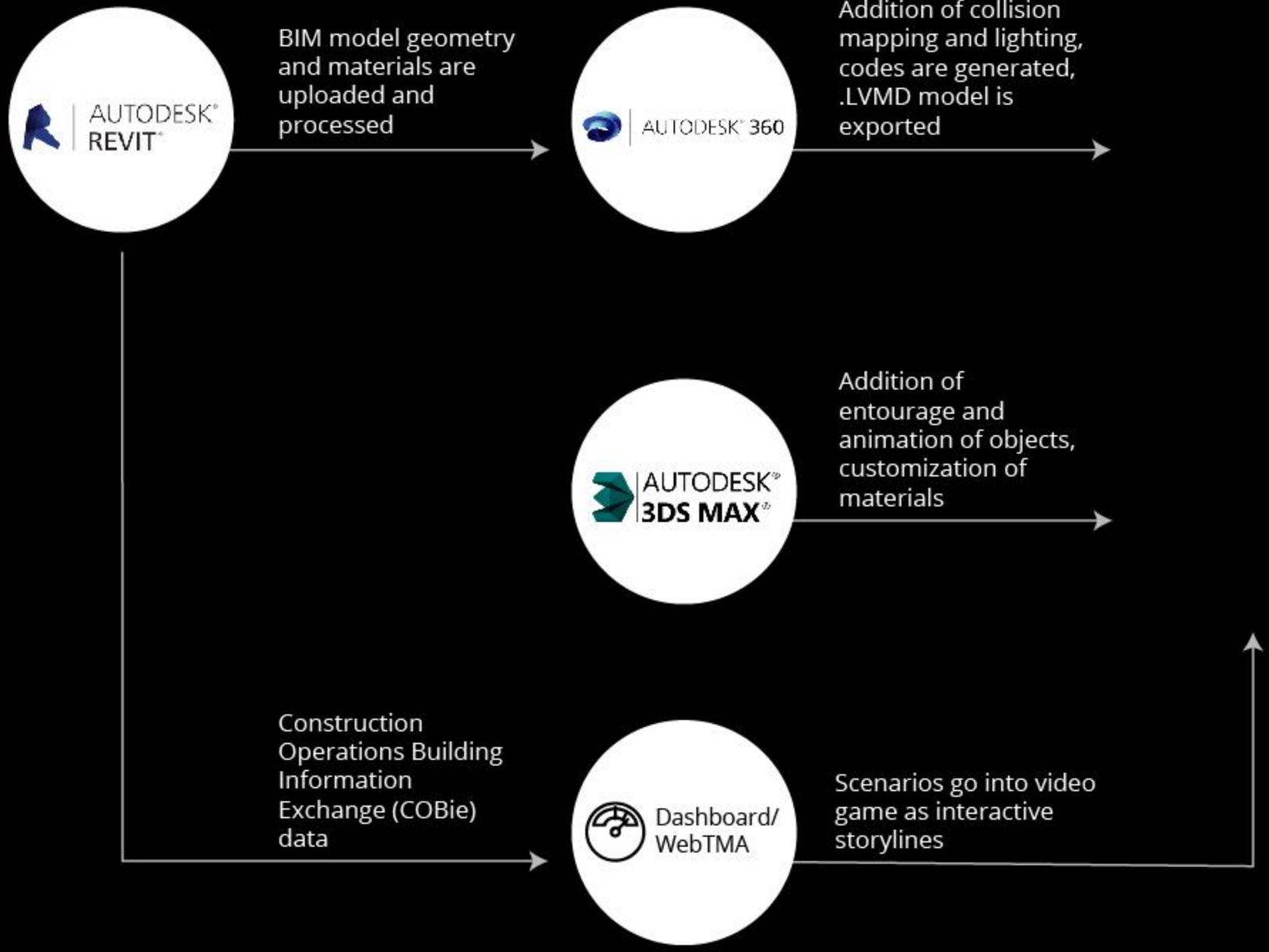


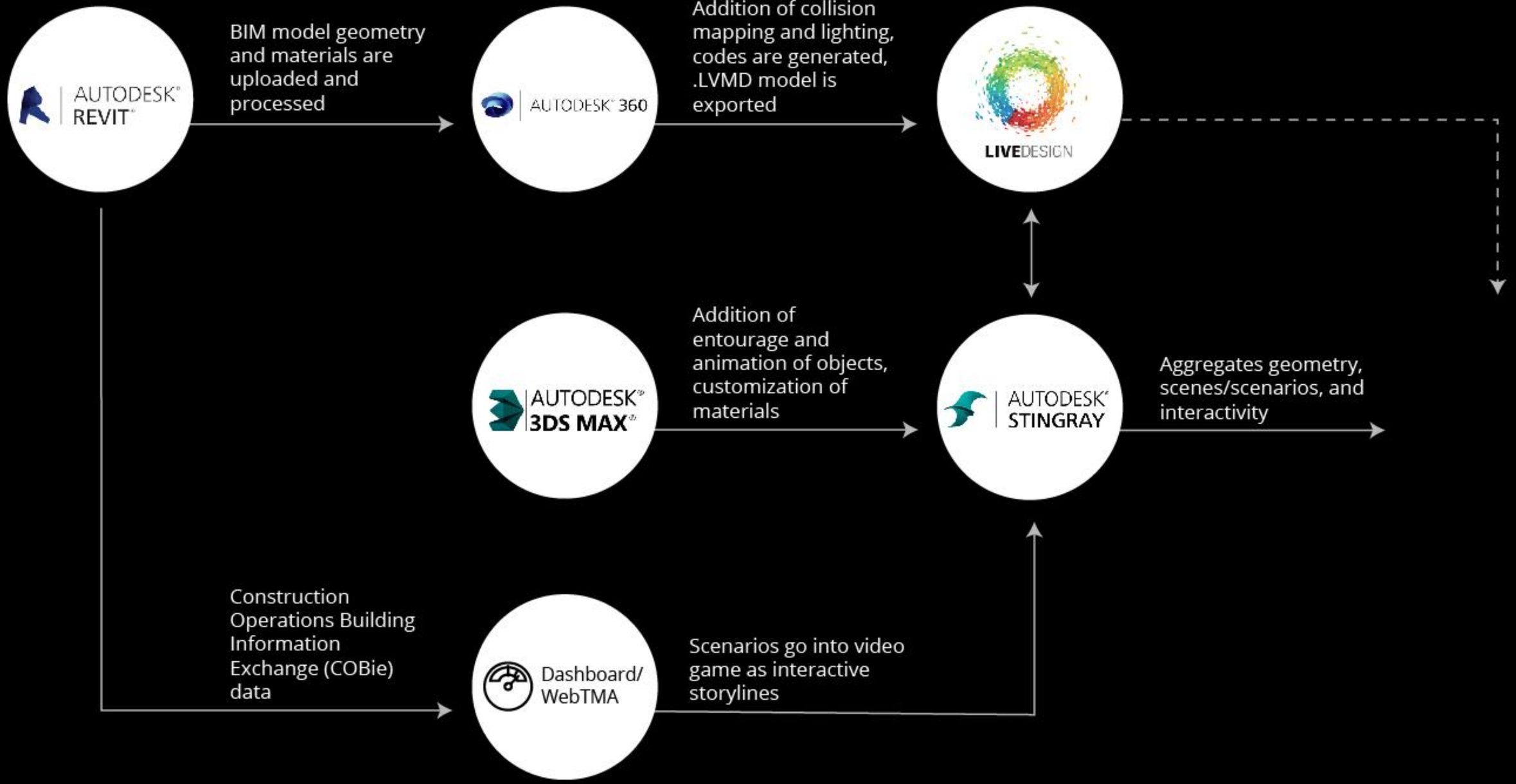
The Path to VR

METHODS AND WORKFLOWS


AUTODESK®
REVIT®


AUTODESK®
REVIT®
BIM model geometry and materials are uploaded and processed
Construction Operations Building Information Exchange (COBie) data


AUTODESK® REVIT®
BIM model geometry and materials are uploaded and processed
AUTODESK® 360
Addition of collision mapping and lighting, codes are generated, .LVMD model is exported
AUTODESK® 3DS MAX®
Addition of entourage and animation of objects, customization of materials
Construction Operations Building Information Exchange (COBie) data
Dashboard/ WebTMA
Scenarios go into video game as interactive storylines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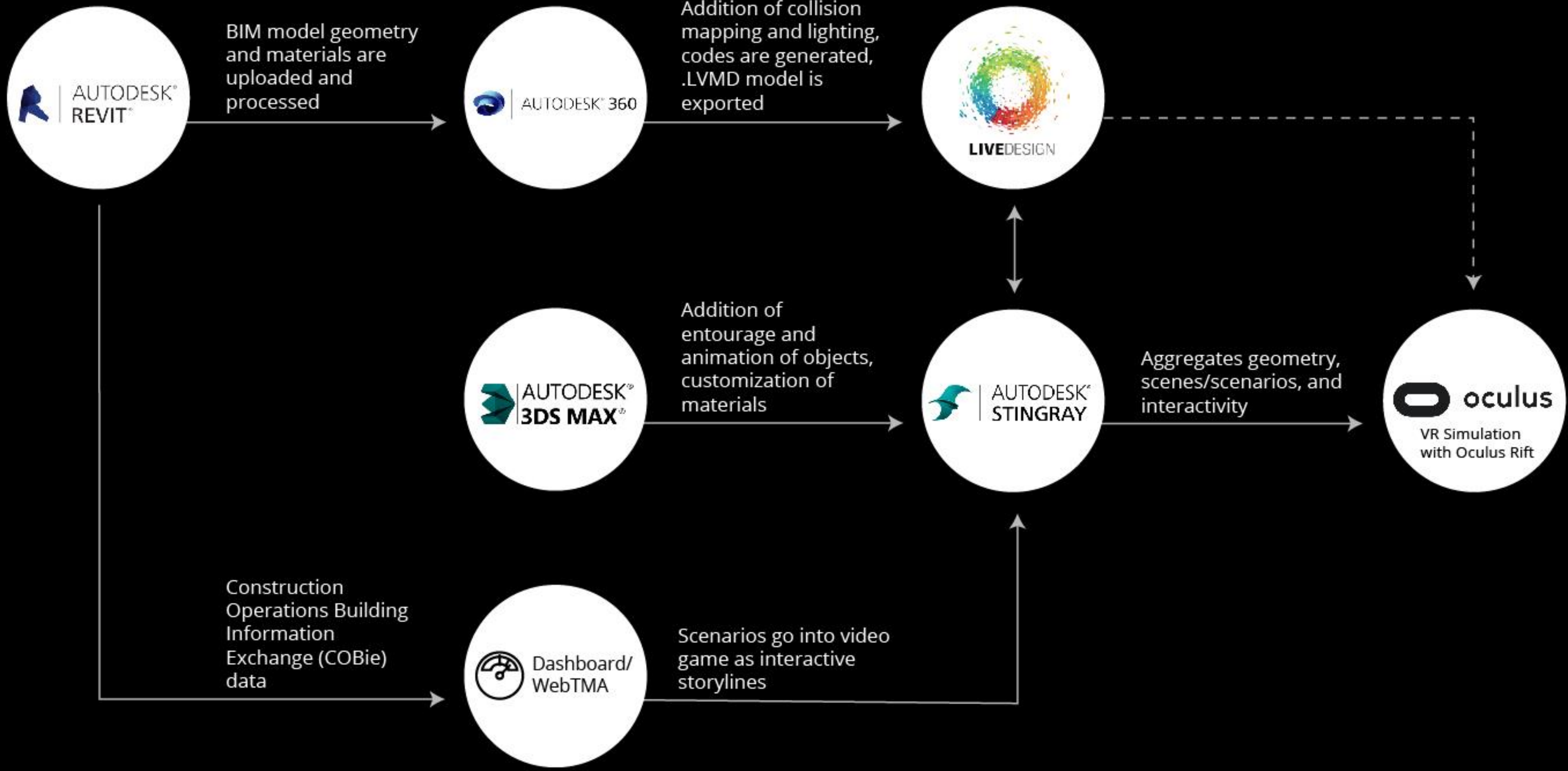
BIM model geometry and materials are uploaded and processed
AUTODESK® 360
Addition of collision mapping and lighting, codes are generated, .LVMD model is exported
LIVEDESIGN
AUTODESK® 3DS MAX®
Addition of entourage and animation of objects, customization of materials
AUTODESK® STINGRAY
Aggregates geometry, scenes/scenarios, and interactivity
Construction Operations Building Information Exchange (COBie) data
Dashboard/ WebTMA
Scenarios go into video game as interactive storylines


AUTODESK® REVIT®
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LIVEDESIGN
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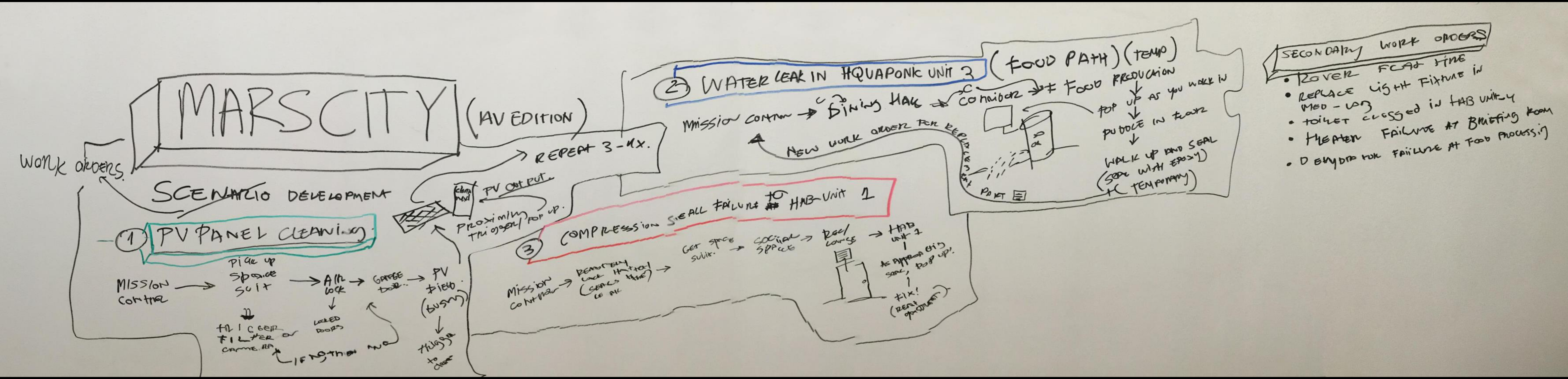
AUTODESK® STINGRAY
Aggregates geometry, scenes/scenarios, and interactivity
oculus
VR Simulation with Oculus Rift
Construction Operations Building Information Exchange (COBie) data
Dashboard/ WebTMA
Scenarios go into video game as interactive storylines


MARSCITY
(AV EDITION)
WORK ORDERS
SCENARIO DEVELOPMENT
REPEAT 3-4X.
1 PV PANEL CLEANING
MISSION CONTROL
PICK UP SPACE SUIT
AIR LOCK
GARAGE
PV FIELD
PV OUTPUT
PROXIMITY TRIGGER / POP UP.
2 WATER LEAK IN AQUAPONIC UNIT 3
(FOOD PATH) (TEMP)
MISSION CONTROL
DINING HALL
CORRIDOR
FOOD PRODUCTION
POP UP AS YOU WALK IN
PUDDLE IN FLOOR
WALK UP AND SEAL
NEW WORK ORDER FOR REPLACEMENT PART
3 COMPRESSION SEAL FAILURE TO HAB UNIT 1
MISSION CONTROL
GET SPACE SUIT
SOCIAL SPACE
HAB UNIT 1
FIX!
SECONDARY WORK ORDERS
• ROVER
• REPLACE LIGHT FIXTURE IN
• TOILET CLOGGED IN HAB UNIT
• HEATER FAILURE AT BRIEFING ROOM

Criticality Table

01 Life Threatening
Requires immediate attention

02 Life Endangering
Overrides all other work orders

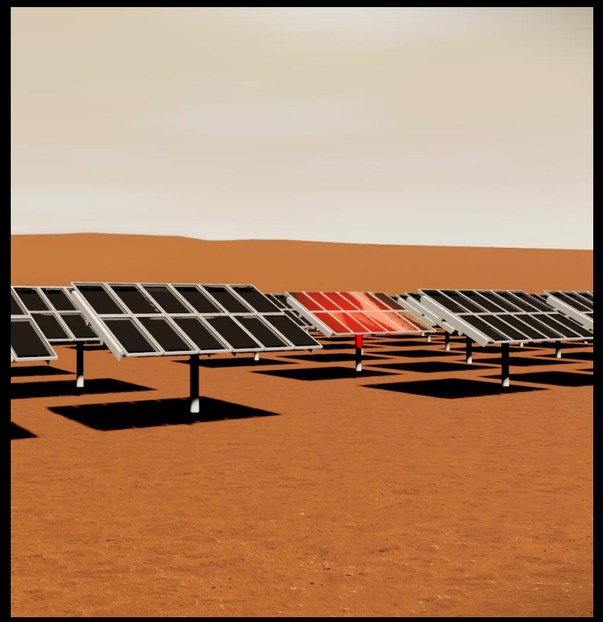
03 High Priority
Critical to continued operation

04 Medium Priority
Necessary for continued operation

05 Low Priority
Can be scheduled as needed

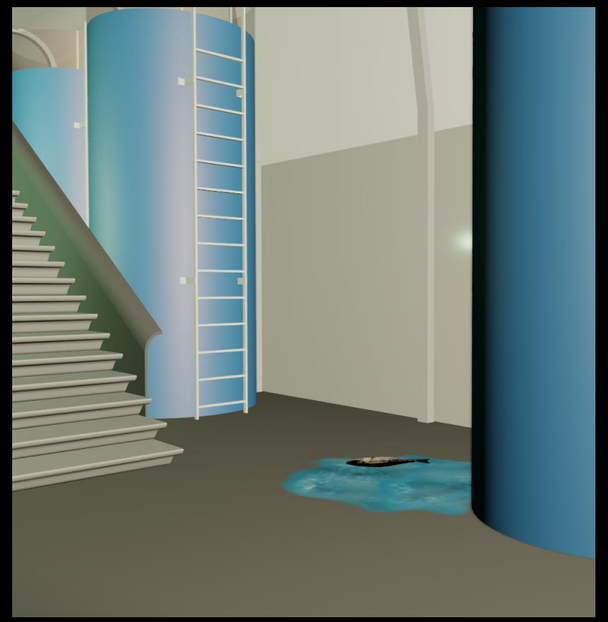
06 Preventative Maintenance
Follows pre-determined schedule

Low Priority



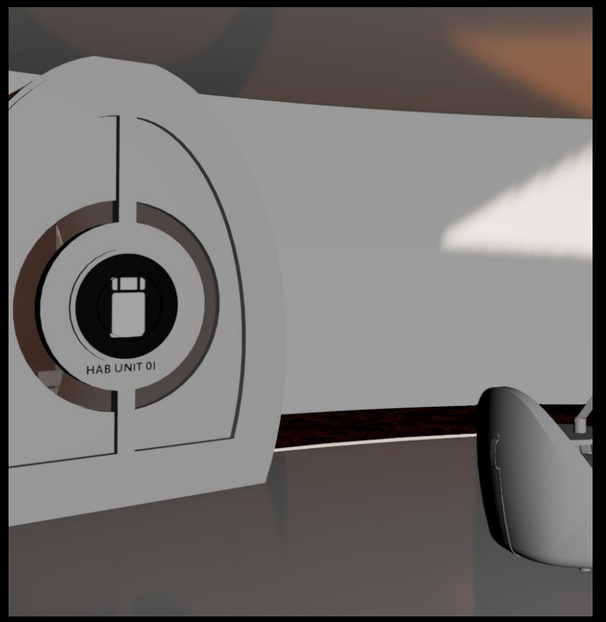
PV Panel Array 02 Cleaning

Medium Priority



Water Leak in Aquaponic Unit 03

High Priority



Compression seal failure Hab 01

Criticality Table

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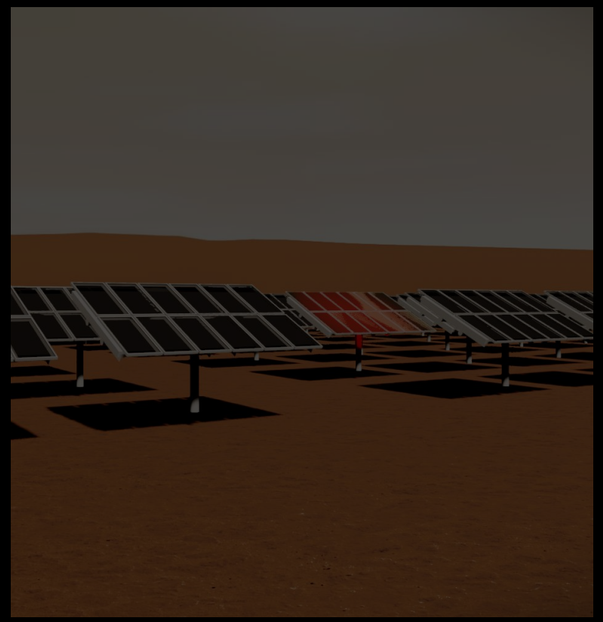
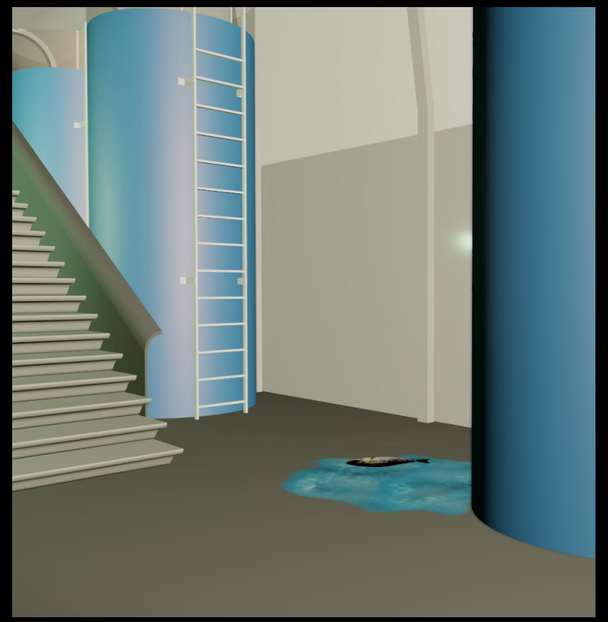
Low Priority



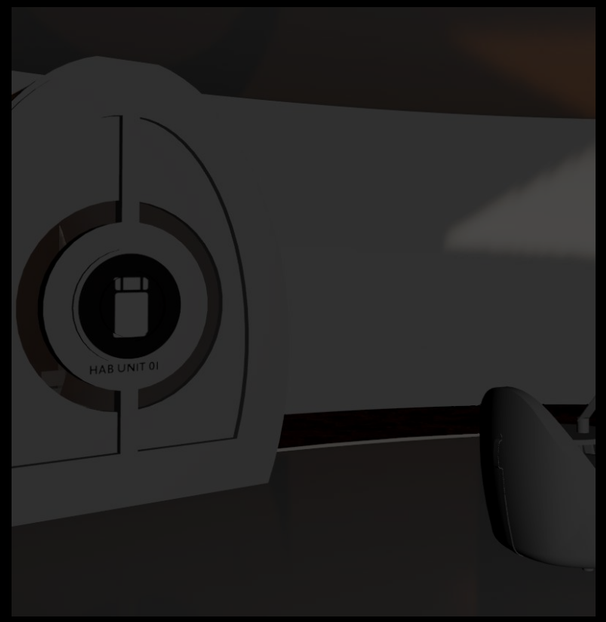
PV Panel Array 02 Cleaning

Medium Priority



Water Leak in Aquaponic Unit 03

High Priority



Compression seal failure Hab 01

01 Mission Control

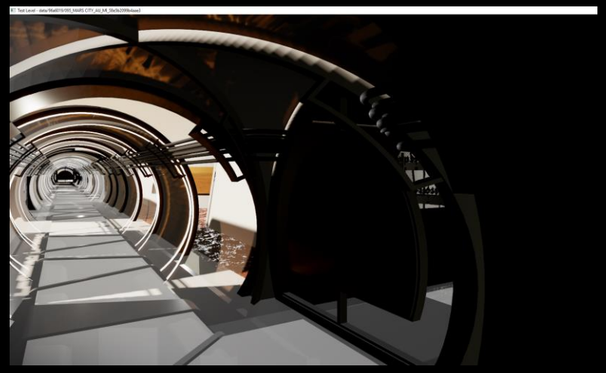
- Start of scenario
- Selection of work order
- Work order pop-up appears
- Action: remote shutdown of water valve

02 Dining Hall

- Walk through space
- Doors open and close

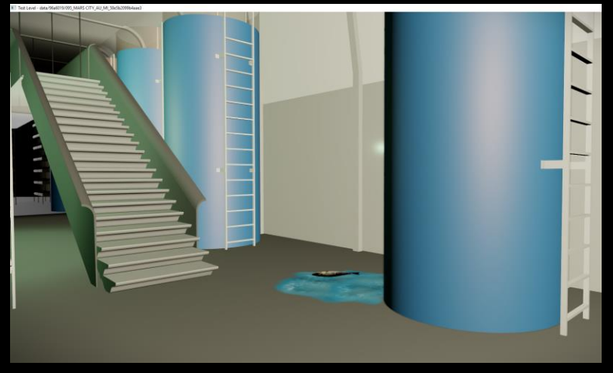
03 Corridor

- Walk through corridor towards Food Production
- Lights turn on



04 Food Production

- Door opens
- Enter Food Production
- Work-order pop-up appears

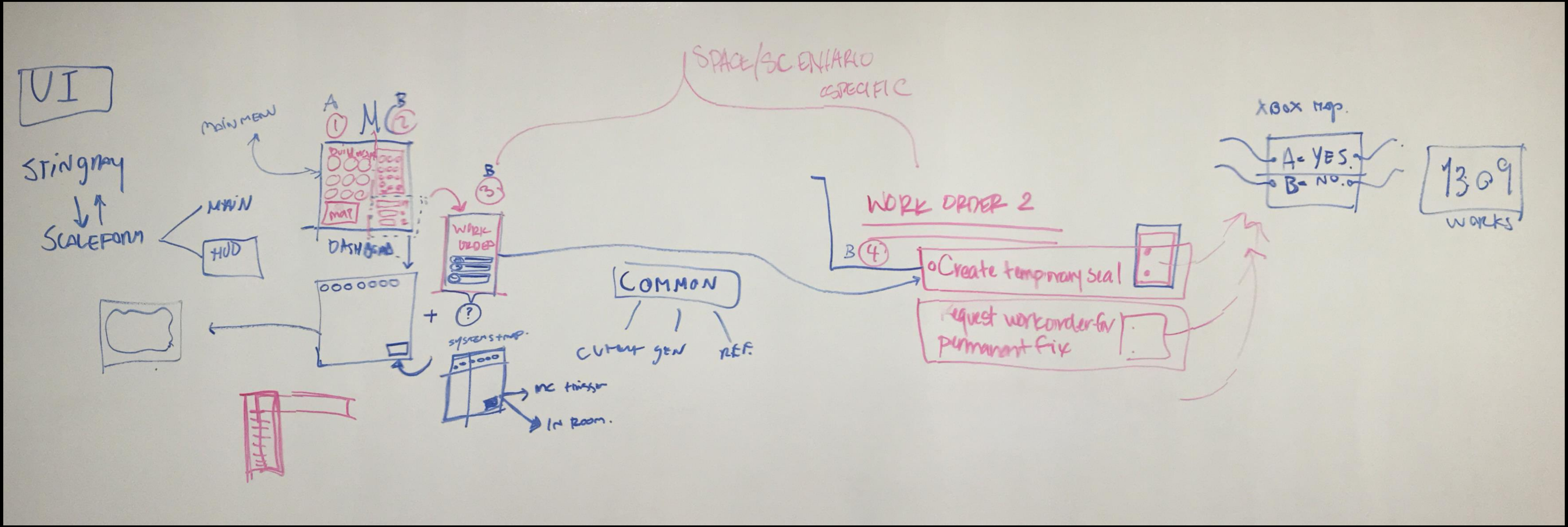


05 Aquaponic Unit 03

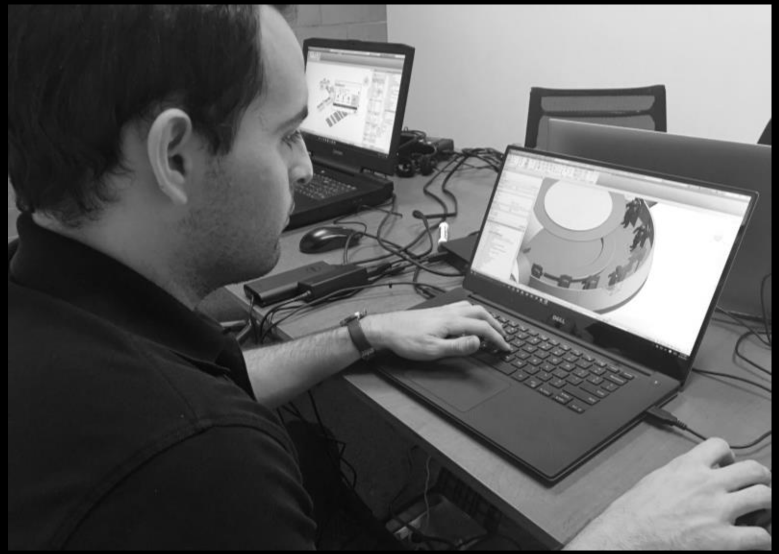
- See water on floor
- See fish and plants
- Selection pop-up appear

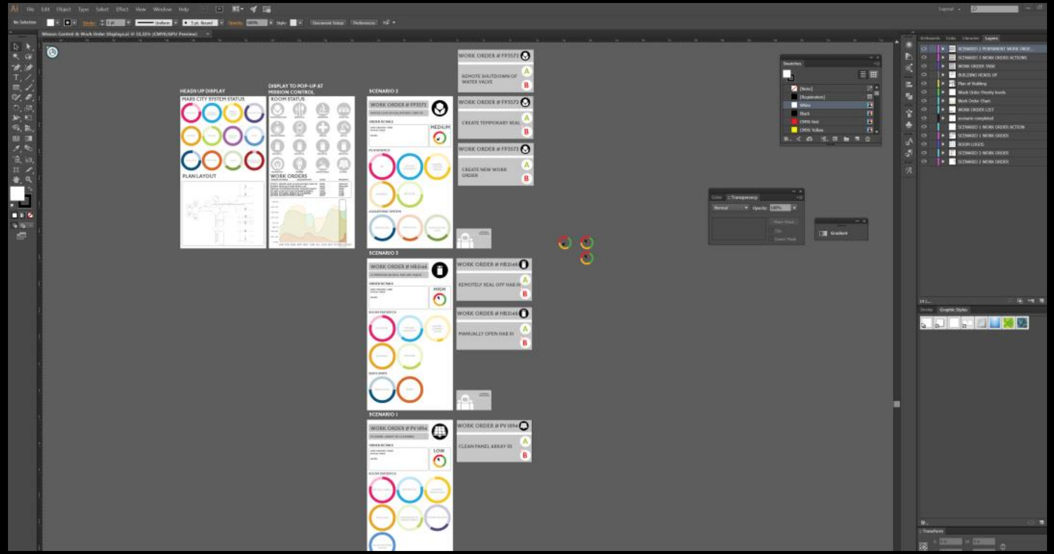
06 Aquaponic Unit 03

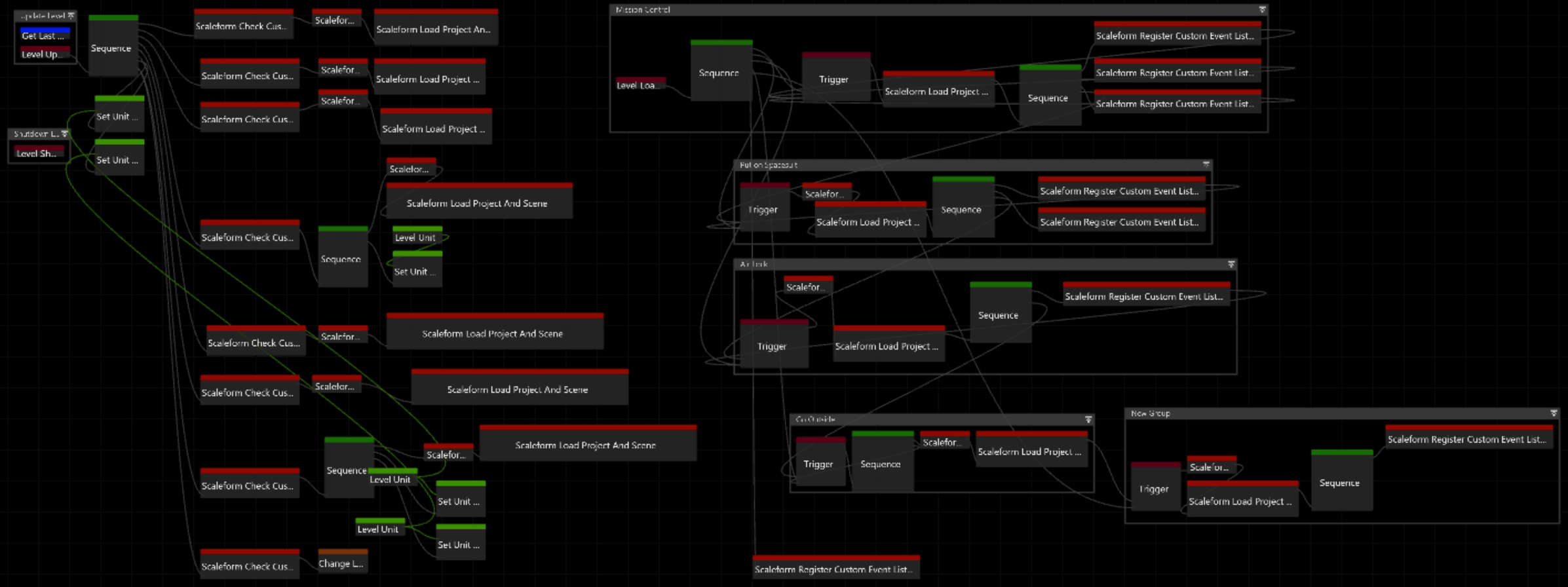
- Action: Create temporary seal
- Seal gets fixed
- Action: Issue new work order for permanent fix


UI
Stingray
Scaleform
MAIN
HUD
main menu
DASHBOARD
WORK ORDER
SPACE/SCENARIO SPECIFIC
COMMON
REF.
WORK ORDER 2
Create temporary seal
request workorder for permanent fix
XBOX map.
A= YES.
B= NO.
1309
works
in room.

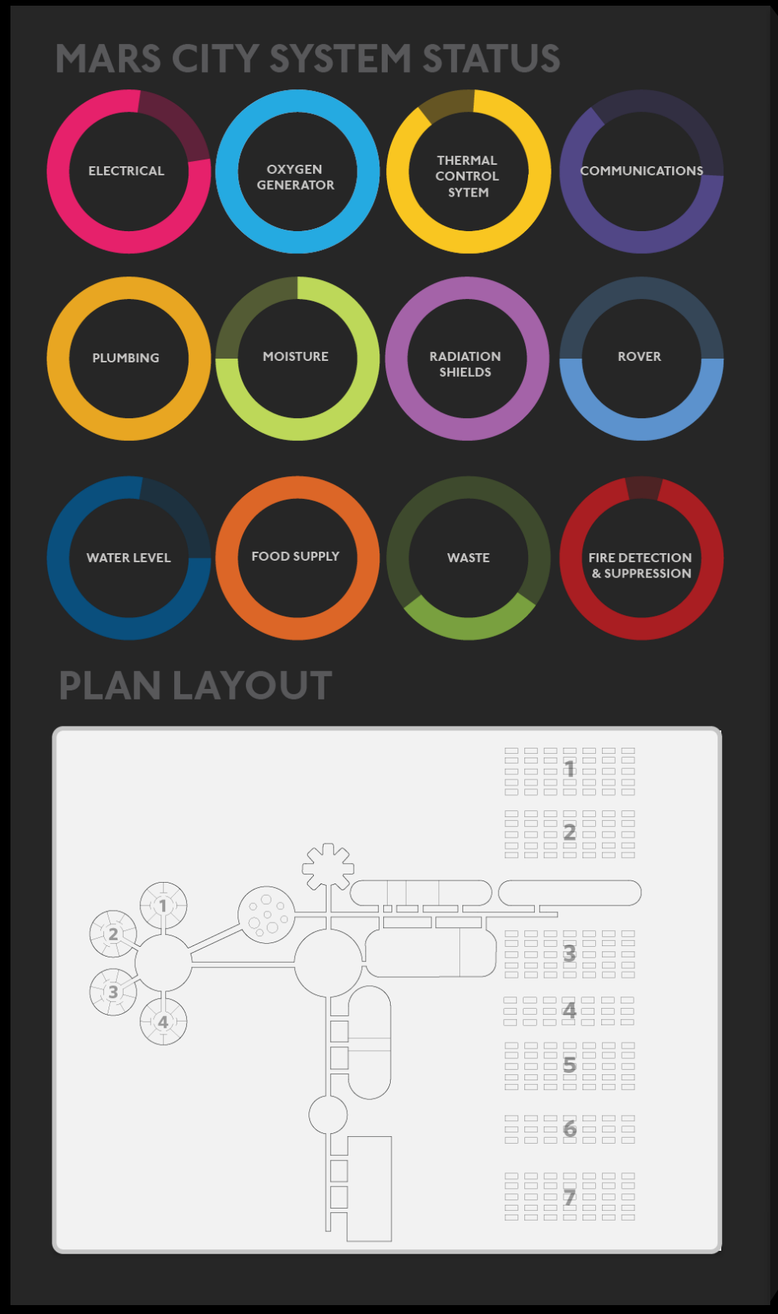

DO YOU

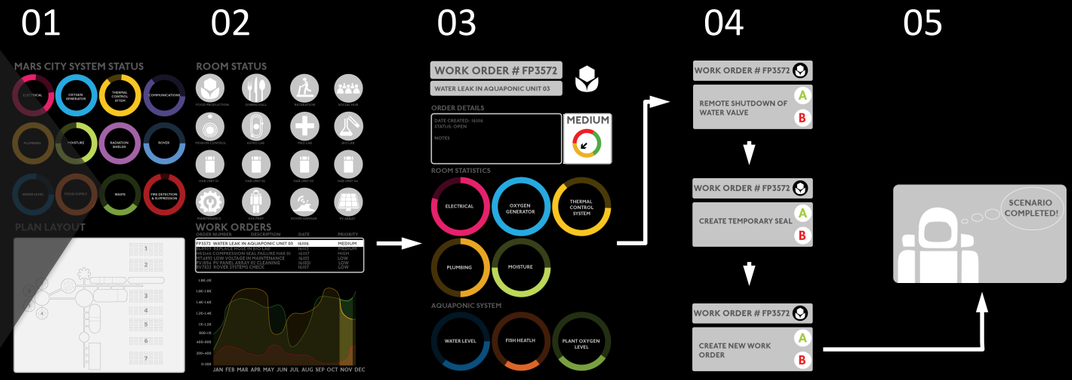




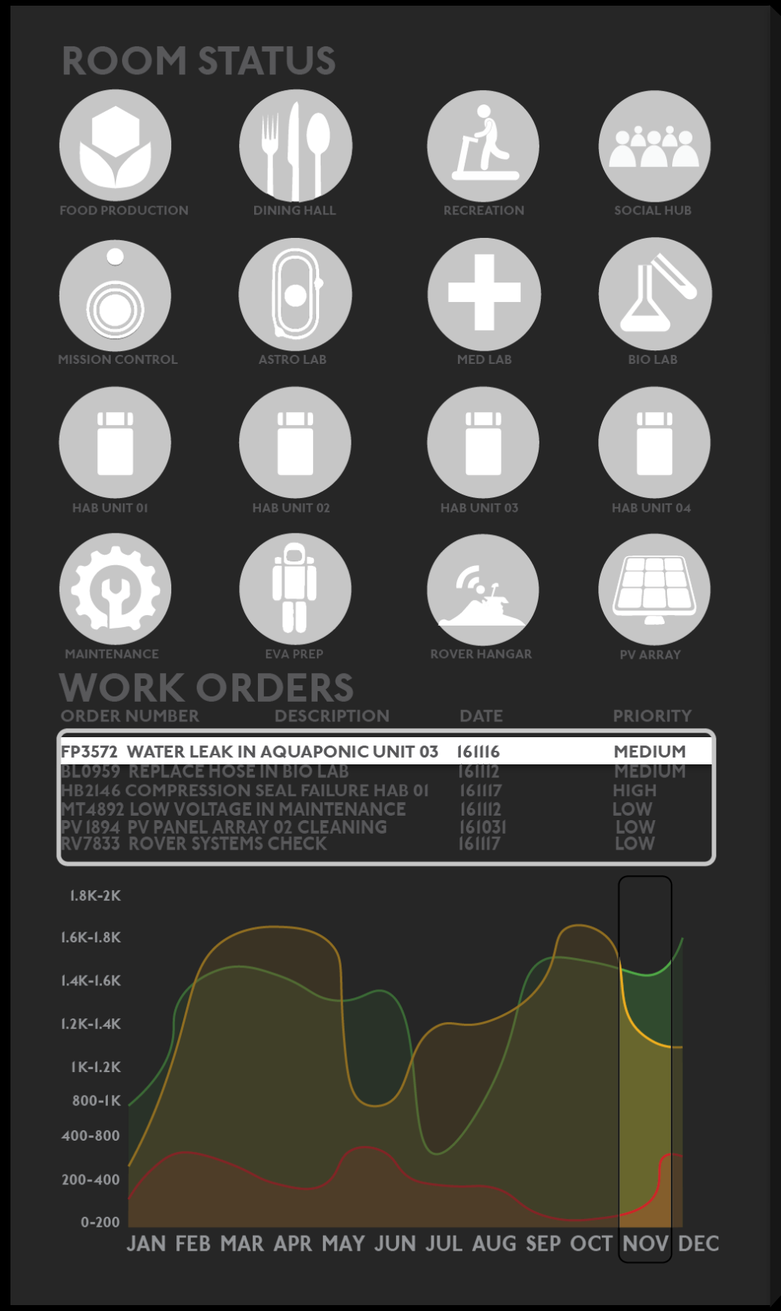


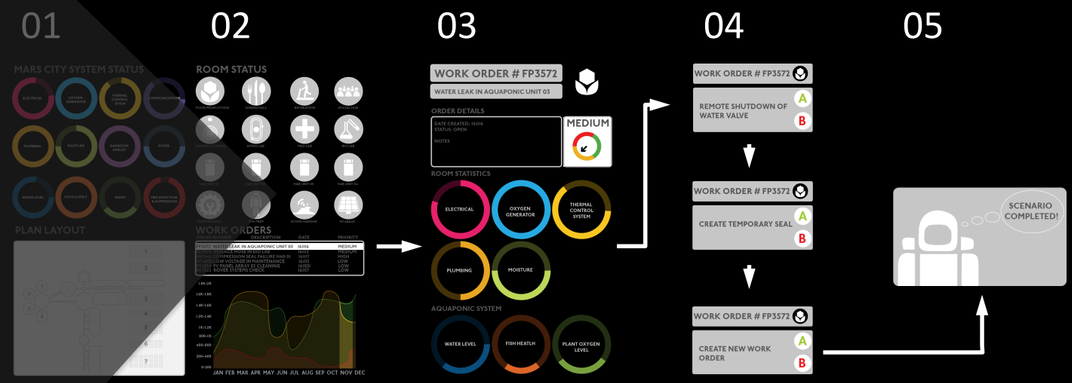
01


MARS CITY SYSTEM STATUS
ELECTRICAL
OXYGEN GENERATOR
THERMAL CONTROL SYTEM
COMMUNICATIONS
PLUMBING
MOISTURE
RADIATION SHIELDS
ROVER
WATER LEVEL
FOOD SUPPLY
WASTE
FIRE DETECTION & SUPPRESSION
PLAN LAYOUT
1
2
3
4
5
6
7


01
MARS CITY SYSTEM STATUS
PLAN LAYOUT
02
ROOM STATUS
WORK ORDERS
03
WORK ORDER # FP3572
WATER LEAK IN AQUAPONIC UNIT 03
ORDER DETAILS
MEDIUM
ROOM STATISTICS
ELECTRICAL
OXYGEN GENERATOR
THERMAL CONTROL SYSTEM
PLUMBING
MOISTURE
AQUAPONIC SYSTEM
WATER LEVEL
FISH HEALTH
PLANT OXYGEN LEVEL
04
WORK ORDER # FP3572
REMOTE SHUTDOWN OF WATER VALVE
A
B
WORK ORDER # FP3572
CREATE TEMPORARY SEAL
A
B
WORK ORDER # FP3572
CREATE NEW WORK ORDER
A
B
05
SCENARIO COMPLETED!

02


ROOM STATUS
FOOD PRODUCTION
DINING HALL
RECREATION
SOCIAL HUB
MISSION CONTROL
ASTRO LAB
MED LAB
BIO LAB
HAB UNIT 01
HAB UNIT 02
HAB UNIT 03
HAB UNIT 04
MAINTENANCE
EVA PREP
ROVER HANGAR
PV ARRAY
WORK ORDERS
ORDER NUMBER DESCRIPTION DATE PRIORITY
FP3572 WATER LEAK IN AQUAPONIC UNIT 03 161116 MEDIUM
BL0959 REPLACE HOSE IN BIO LAB 161112 MEDIUM
HB2146 COMPRESSION SEAL FAILURE HAB 01 161117 HIGH
MT4892 LOW VOLTAGE IN MAINTENANCE 161112 LOW
PV 1894 PV PANEL ARRAY 02 CLEANING 161031 LOW
RV7833 ROVER SYSTEMS CHECK 161117 LOW
1.8K-2K
1.6K-1.8K
1.4K-1.6K
1.2K-1.4K
1K-1.2K
800-1K
400-800
200-400
0-200
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


01
02
03
04
05
MARS CITY SYSTEM STATUS
ROOM STATUS
PLAN LAYOUT
WORK ORDERS
WORK ORDER # FP3572
WATER LEAK IN AQUAPONIC UNIT 03
ORDER DETAILS
MEDIUM
ROOM STATISTICS
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THERMAL CONTROL SYSTEM
PLUMBING
MOISTURE
AQUAPONIC SYSTEM
WATER LEVEL
FISH HEALTH
PLANT OXYGEN LEVEL
WORK ORDER # FP3572
REMOTE SHUTDOWN OF WATER VALVE
A
B
WORK ORDER # FP3572
CREATE TEMPORARY SEAL
A
B
WORK ORDER # FP3572
CREATE NEW WORK ORDER
A
B
SCENARIO COMPLETED!

03

WORK ORDER # FP3572

WATER LEAK IN AQUAPONIC UNIT 03

ORDER DETAILS

DATE CREATED: 161116
STATUS: OPEN

NOTES

MEDIUM

ROOM STATISTICS

ELECTRICAL

OXYGEN GENERATOR

THERMAL CONTROL SYSTEM

PLUMBING

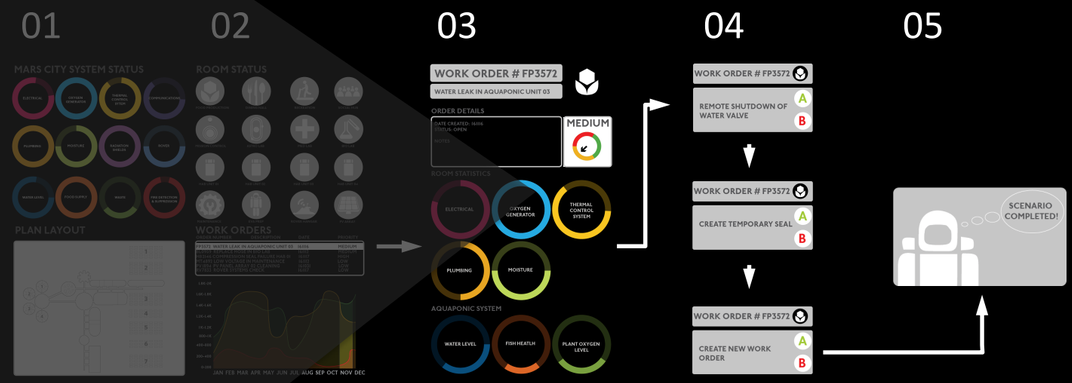
MOISTURE

AQUAPONIC SYSTEM

WATER LEVEL

FISH HEATLH

PLANT OXYGEN LEVEL



04

WORK ORDER # FP3572

REMOTE SHUTDOWN OF WATER VALVE

A

B

WORK ORDER # FP3572

CREATE TEMPORARY SEAL

A

B

WORK ORDER # FP3572

CREATE NEW WORK ORDER

A

B

05


SCENARIO
COMPLETED!


01
02
03
04
05
MARS CITY SYSTEM STATUS
ROOM STATUS
PLAN LAYOUT
WORK ORDERS
WORK ORDER # FP3572
WATER LEAK IN AQUAPONIC UNIT 05
ORDER DETAILS
MEDIUM
ROOM STATISTICS
ELECTRICAL
OXYGEN GENERATOR
THERMAL CONTROL SYSTEM
PLUMBING
MOISTURE
AQUAPONIC SYSTEM
WATER LEVEL
FISH HEALTH
PLANT OXYGEN LEVEL
WORK ORDER # FP3572
REMOTE SHUTDOWN OF WATER VALVE
A
B
WORK ORDER # FP3572
CREATE TEMPORARY SEAL
A
B
WORK ORDER # FP3572
CREATE NEW WORK ORDER
A
B
SCENARIO COMPLETED!

01

02

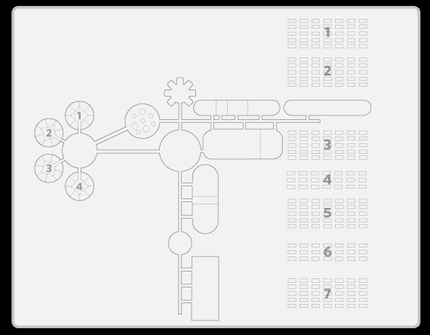
03

04

05

MARS CITY SYSTEM STATUS

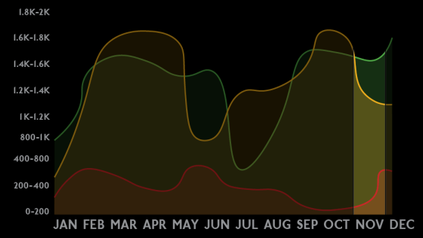
PLAN LAYOUT



ROOM STATUS

WORK ORDERS

ORDER NUMBER	DESCRIPTION	DATE	PRIORITY
FP3572	WATER LEAK IN AQUAPONIC UNIT 03	161116	MEDIUM
BL0959	REPLACE HOSE IN BIO LAB	161112	MEDIUM
HB2146	COMPRESSION SEAL FAILURE HAB 01	161117	HIGH
MT4892	LOW VOLTAGE IN MAINTENANCE	161112	LOW
PV1894	PV PANEL ARRAY 02 CLEANING	161031	LOW
RV7833	ROVER SYSTEMS CHECK	161117	LOW



WORK ORDER # FP3572

WATER LEAK IN AQUAPONIC UNIT 03

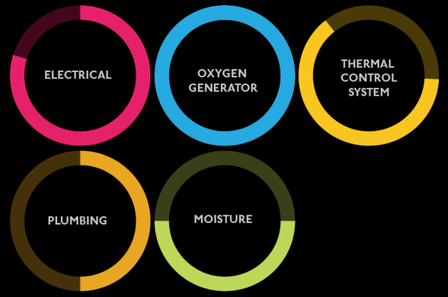
ORDER DETAILS

DATE CREATED: 161116
STATUS: OPEN

NOTES

MEDIUM

ROOM STATISTICS



AQUAPONIC SYSTEM

WORK ORDER # FP3572

REMOTE SHUTDOWN OF WATER VALVE

A

B

WORK ORDER # FP3572

CREATE TEMPORARY SEAL

A

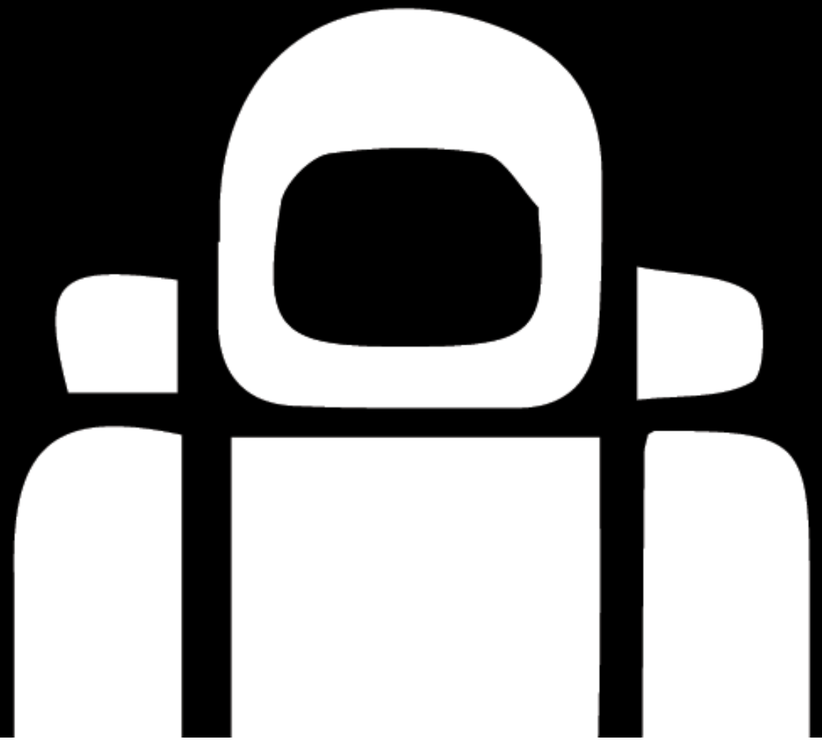
B

WORK ORDER # FP3572

CREATE NEW WORK ORDER

A

B



VISIT MARS CITY

Criticality Table

01 Life Threatening
Requires immediate attention

02 Life Endangering
Overrides all other work orders

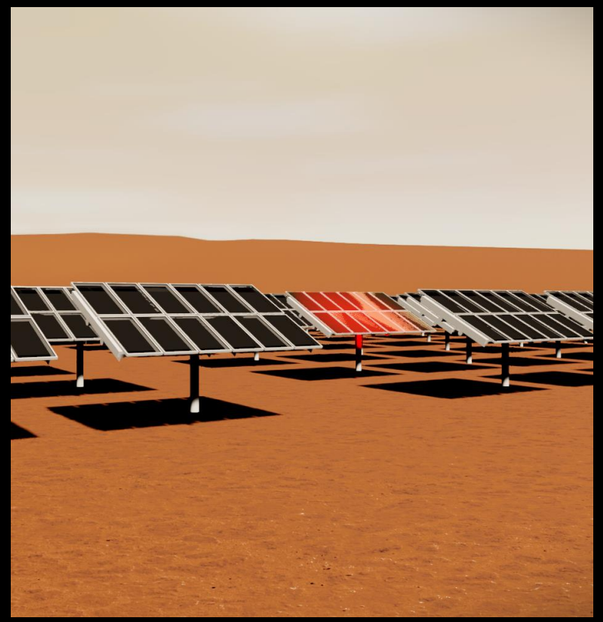
03 High Priority
Critical to continued operation

04 Medium Priority
Necessary for continued operation

05 Low Priority
Can be scheduled as needed

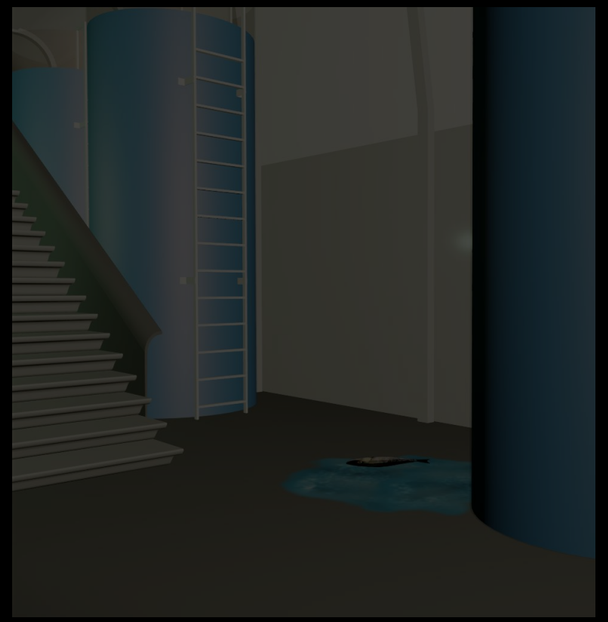
06 Preventative Maintenance
Follows pre-determined schedule

Low Priority



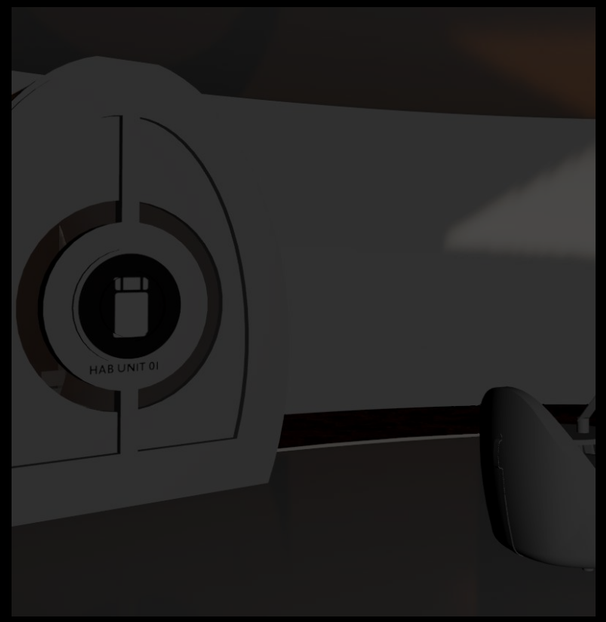
PV Panel Array 02 Cleaning

Medium Priority



Water Leak in Aquaponic Unit 03

High Priority



Compression seal failure Hab 01


MARS CITY
FACILITY OPS CHALLENGE
START
QUIT

Resources

STEM Education & Mars Facility Ops Challenge

- National Institute of Building Sciences (NIBS)
  http://www.nibs.org/?page=stem
- Total Learning Research Institute (TLRI)
  http://www.tlri.org/
- Mars Facilities Ops Challenge
  http://www.nibs.org/marscity

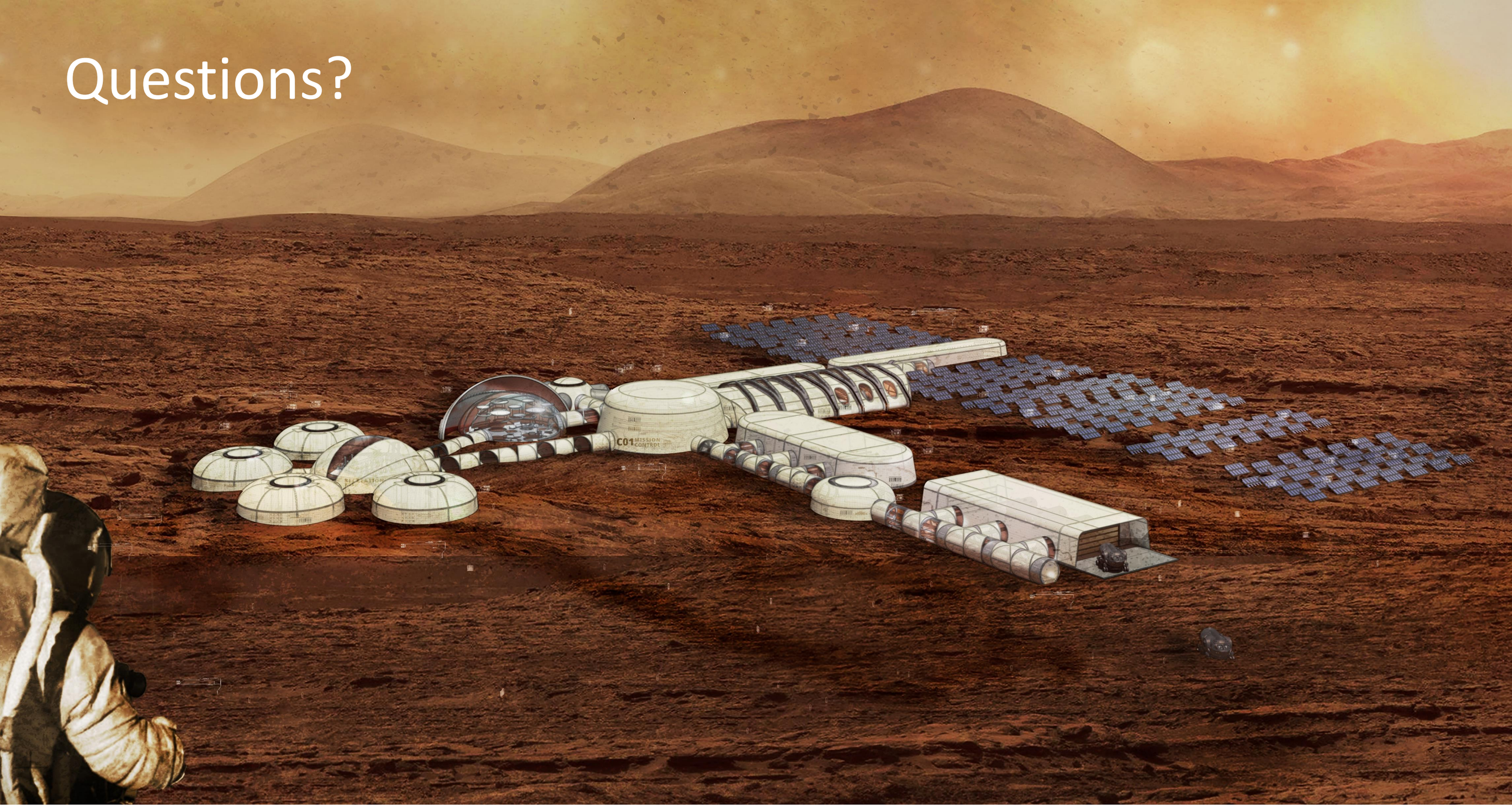
Autodesk LIVE

- General Overview
  http://www.autodesk.com/products/live/overview

Stingray

- General Overview
  http://help.autodesk.com/view/Stingray/ENU/?guid=__stingray_help_getting_started_what_is_stingray_html

Questions?



How did we do?

- Your class feedback is critical. Fill out a **class survey** now.
- Use the AU mobile app or fill out a class survey online.
- Give feedback after each session.
- AU speakers will get feedback in real-time.
- **Your feedback results in better classes and a better AU experience.**