USAP Proof of Concept Projects
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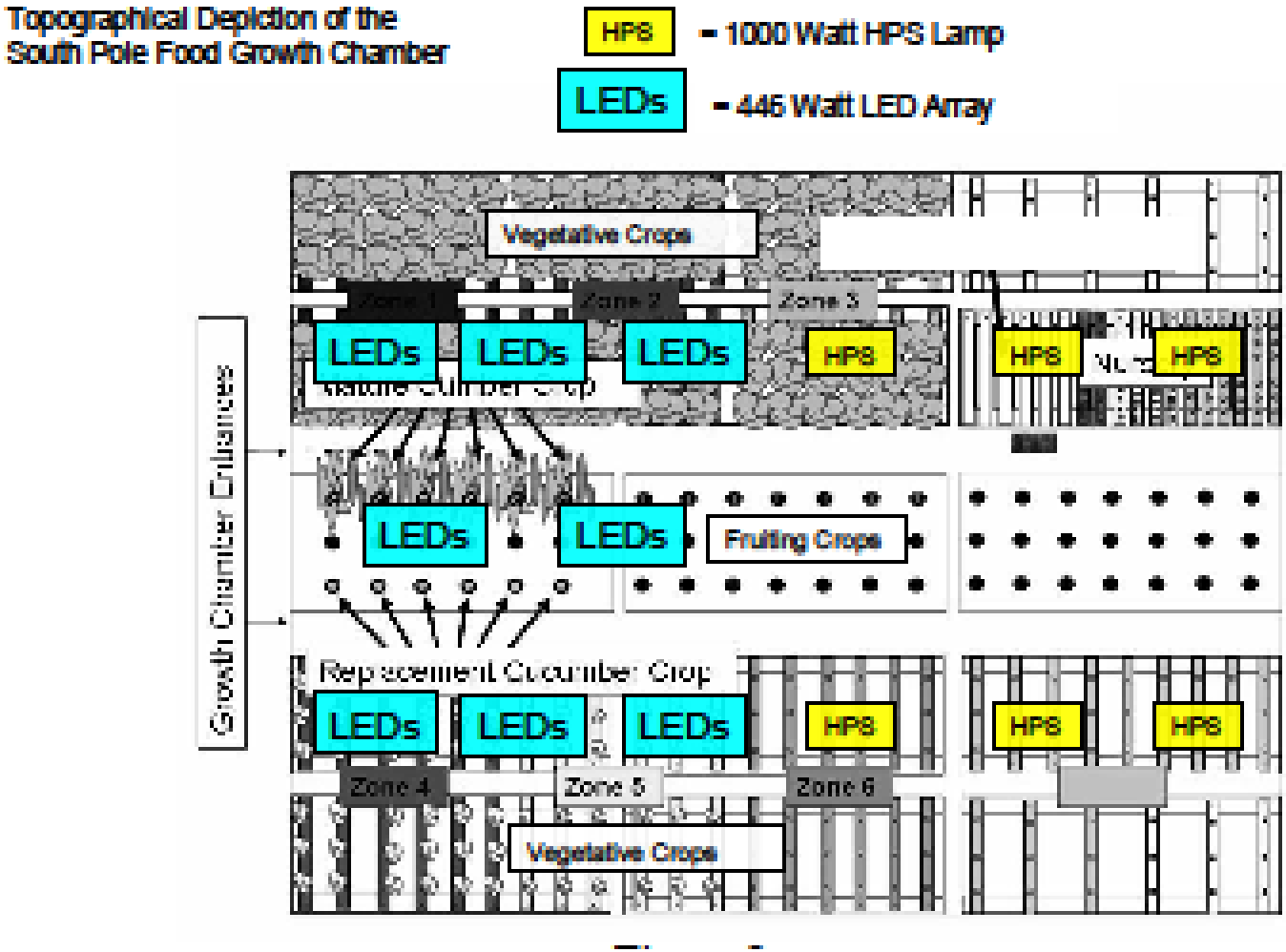
- LED Greenhouse Lighting
- LED Cold Location Lighting
- Solar Garage
- Capacitor Batteries
- Solar Voltaic
- Solar Thermal
- Plyboo Furniture
- South Pole Solar Camp

South Pole Food Growth Chamber

- Parameters controlled:
  - 14 hours high PAR **lighting**
  - 1,000 PPM **CO2**
  - 60% **RH**
  - 23-25 Deg C daytime
  - 22-24 Deg C evening
  - **PH** 6.3 water
  - **Nutrient** levels

South Pole Test Layout



Comparing Light Sources

Light Source	LER	Lm/W	K factor	Delivered µmol/W	Lamp Life (hrs)	Estimated Total Energy used	Estimated Energy Savings	Estimated gallon of fuel saved
HPS (400W)	67%	130	0.012	0.65	16,000	**13 kW**	NA	NA
LSGC Grow (50W*)	88%	50	0.024	1.25	50,000	**6.8 kW**	6.2 kW	1,967

*Can be scaled up to any wattage with similar efficiency.

Comparison

Input Wattage	66	45	50
PAR [µmol]	92.71	66.25	**70.51**
PAR/W [µmol/W]	1.4	1.5	**1.4**
YPF [µmol]	72.05	49.72	**61.20**
YPF/W [µmol/W]	1.1	1.1	**1.2**
Color Temp. (CCT)	1,509	3,050	**3,826**
CRI	-181	69	**74**

Cold Space (-60F) LED Lighting

- Changed all incandescent to Lighting Science Group Inc (LSGI) LED in **Storage Arch**
- Changing **snow tunnel** lights to LED
  - Some brands pulsed on and off till warm
  - Found one brand that did not pulse
  - Operate and start with -60F ambient
- Reduced energy 130 W to 18 W per lamp
- One year savings at Storage Arch :
  - 4.2 kW demand
  - 2,812 Gallon/year generator fuel
  - $58,389/year saved

Solar Garage

- Under test at Fairbanks, Alaska
- Cost under $25,000
- Various sizes available
- Modular sizing approach
- Translucent fabric structure
- Investigating new material for low temperature handling, fire resistance, insulation quality (R-8)
- Aluminum tubular frame
- Outer fabric would be clear UV resistant
- Inner heater fabric would be black
- Utilizes convective, conductive, and radiant heat transfer
- Black rubber matting on floor absorbs heat and radiates up
- Twelve inch thick SIP panel insulates floor

Advantages

- Install in <1 hour with 3-4 people
- Fabric and frame weighs less than 100 lbs ea
- Two packages carry entire structure
- No electricity needed
- No tools needed
- Can accept external heater if needed
- Summer time application with sun only
- Insulated floor

Applications

- Equipment storage garage
- Shelter for equipment inspection/repair
- Temporary storage (C-130 engines)
- Emergency garage for traverse/equipment repairs
- Science staging shelter
  - McMurdo science staging
  - WISSARD equipment staging
- Construction sub assembly and staging
- Temporary office

Install Fabric over Frame

Connect two halves of fabric

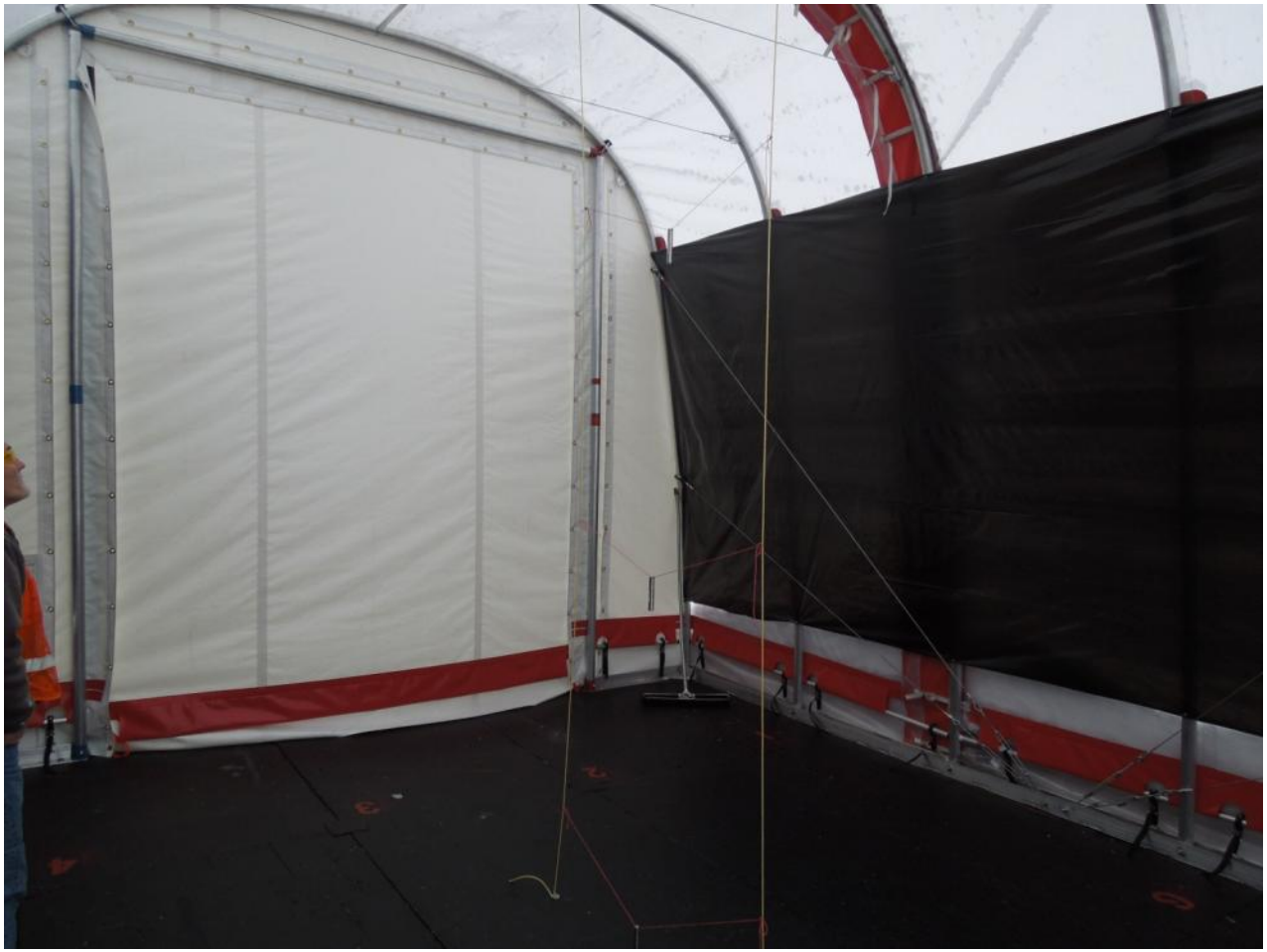
Stitch two halves together

Two halves assembled

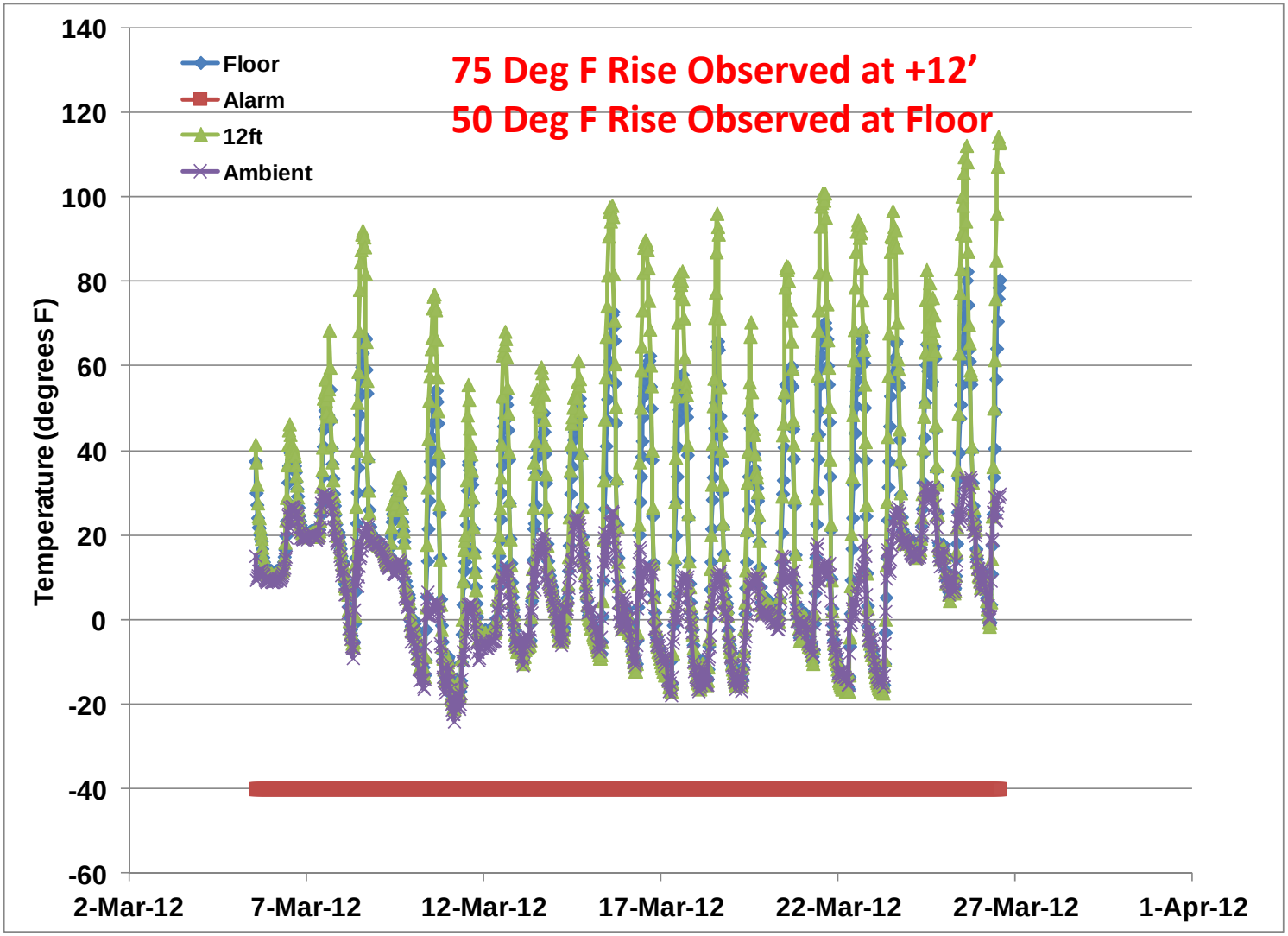
Fairbanks Test Build Unit

Garage with Radiant Heaters

Garage with radiant panels



Fairbanks Plotted Data



Capacitor Batteries

- Cycle life >.5 million vs <1,000 for lead acid
- No problems with cold temperatures (-40F)
- Much lighter (1/5 as heavy as lead acid)
- Recharge time 0.5 minutes vs. 8 hours
- Shelf life unlimited
- Very low self discharge rate
- High Power / short term
- Excellent potential hybrid system with battery

Capacitor Battery

Hybrid Installation

- Capacitor with lead acid battery hybrid
- Produce 1200 Amp at very low temperatures

Potential Applications

- Grid stabilization
- Start up assist with electric vehicles
- Start up booster for large engines
- Lightweight, portable booster battery
- Aviation starter battery
- Emergency battery/power source

Solar Voltaic

175 Watt Sharp Panels at South Pole 2-year daylight stats:

- North: 9.68 kWh/week
- South: 10.38 kWh/week
- East: 10.45 kWh/week
- West: 8.69 kWh/week
- Horizontal: 9.28 kWh/wk

Solar Thermal at Pole Summer Camp

- Installed 4 panels
- Application will work
- POC had not been commissioned:
  - Control problems
  - Dumping heat down water well
  - Plumbing issues

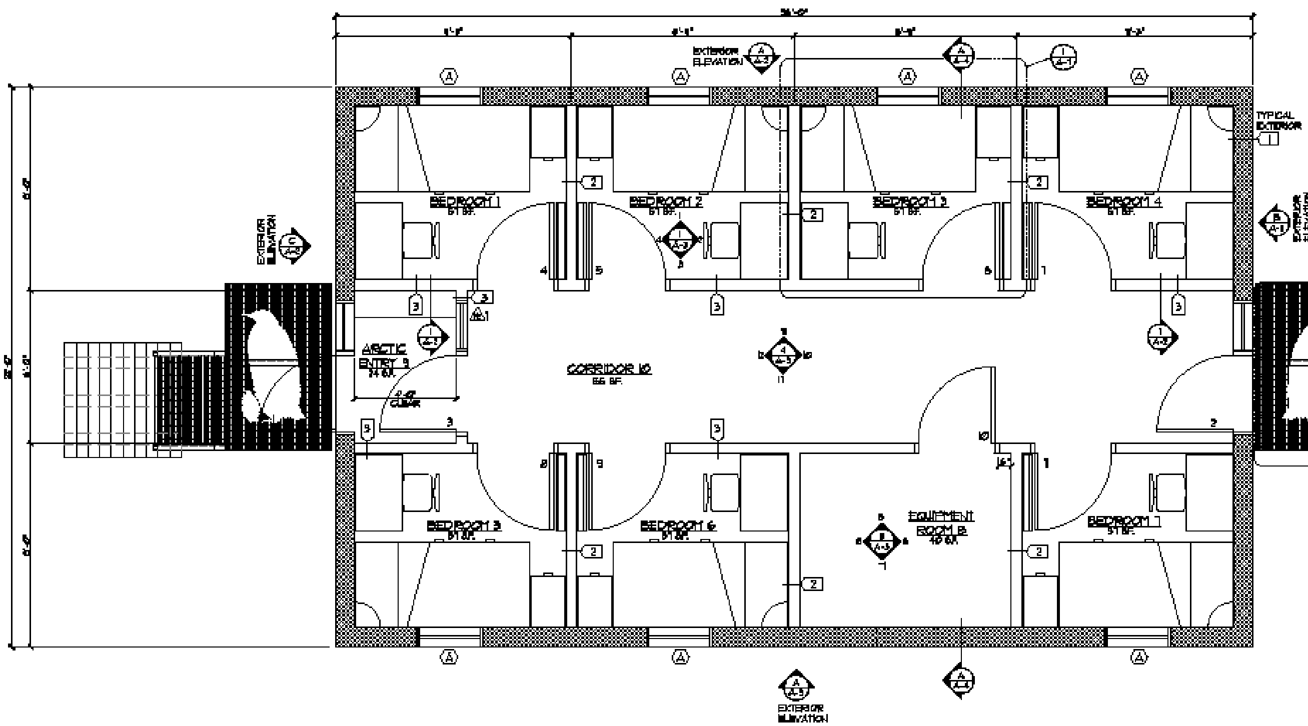
Plyboo Furniture

- Sustainable Bamboo materials
- Steam pressed to form plyboo plywood
- No or very low VOCs

South Pole Solar Camp POC

- Seven single status bedrooms
- Connected to grid
- Generates more power than used
- Slab heat system
- Solar thermal heating
- Solar voltaic power generation
- Passive solar lighting
- On skids, towable

South Pole Solar Camp Plan



LIVING MODULE PLAN

SCALE: 1/2" = 1'-0" (22x34 DRAWING) 1/4" = 1'-0" (11x17 DRAWING)

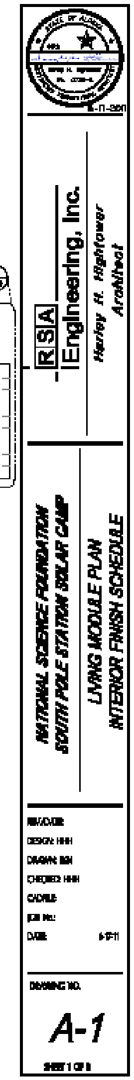
2 - FIRE EXTINGUISHER

REFER TO MECHANICAL AND ELECTRICAL DRAWINGS FOR ADDITIONAL INFORMATION.

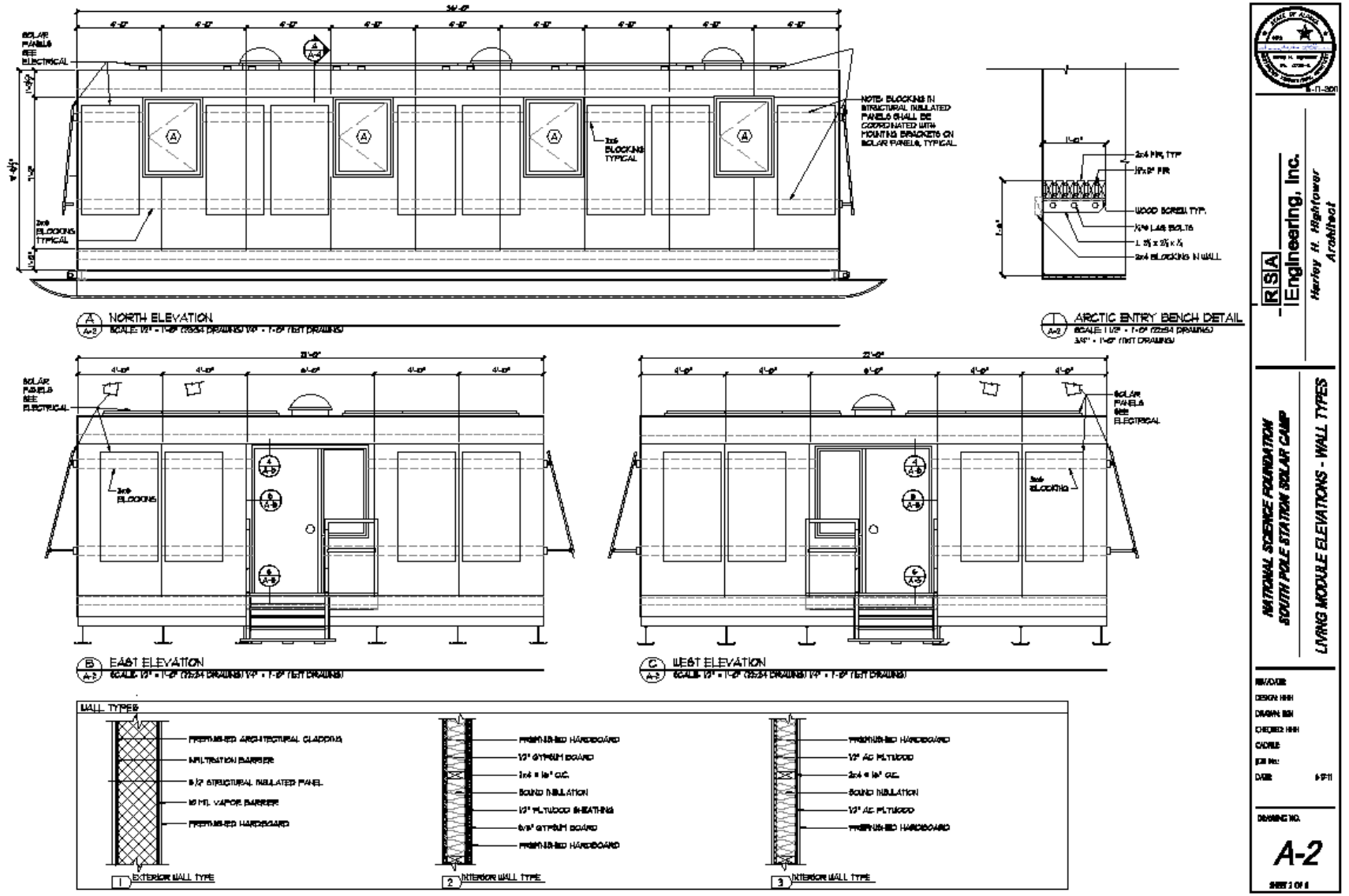
INTERIOR FINISH SCHEDULE

FINISH ABBREVIATIONS:
PFHB = PRE-FINISHED HARDBOARD
RHFS = RADIANT HEAT FLOOR SYSTEM

ROOM NUMBER	ROOM DESCRIPTION	FLOORS			WALL NORTH		WALL EAST		WALL SOUTH		WALL WEST		CEILING			ROOM NUMBER
		MATERIAL	FINISH	BASE	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	HEIGHT	
1	BEDROOM	RHFS	CARPET TILE	RUBBER	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	7'-3 ¾"	1
2	BEDROOM	RHFS	CARPET TILE	RUBBER	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	7'-3 ¾"	2
3	BEDROOM	RHFS	CARPET TILE	RUBBER	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	7'-3 ¾"	3
4	BEDROOM	RHFS	CARPET TILE	RUBBER	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	7'-3 ¾"	4
5	BEDROOM	RHFS	CARPET TILE	RUBBER	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	7'-3 ¾"	5
6	BEDROOM	RHFS	CARPET TILE	RUBBER	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	7'-3 ¾"	6
7	BEDROOM	RHFS	CARPET TILE	RUBBER	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	7'-3 ¾"	7
8	EQUIPMENT ROOM	RHFS	SHEET VINYL	INTEGRAL	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	GYPSUM BOARD	PFHB	PLYWOOD	PFHB	7'-3 ¾"	8
9	ARCTIC ENTRY	RHFS	RUBBER TILE	RUBBER	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	7'-4 ½"	9
10	CORRIDOR	RHFS	CARPET TILE	RUBBER	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	PLYWOOD	PFHB	7'-4 ½"	10



South Pole Solar Camp Elevation



RSA Engineering, Inc.
Harley H. Hightower
Architect

NATIONAL SCIENCE FOUNDATION
SOUTH POLE STATION SOLAR CAMP

LIVING MODULE ELEVATIONS - WALL TYPES

REV/DATE
DESIGN: HHH
DRAWN: BSH
CHECKED: HHH
CADFILE
JOB No:
DATE: 6-9-11

DRAWING NO.
A-2

SHEET 2 OF 8