Greenhouse Growing Season Extended with Hydroelectric Power

Sustainable Food Production in Haines

May 2011

Two Renewable Energy Systems and Sustainable Food Production

- Hydroelectric power
- Greenhouse
  - Insulated, hydronically-heated beds
  - Lights
  - Automatic drip watering system

Hydroelectric system

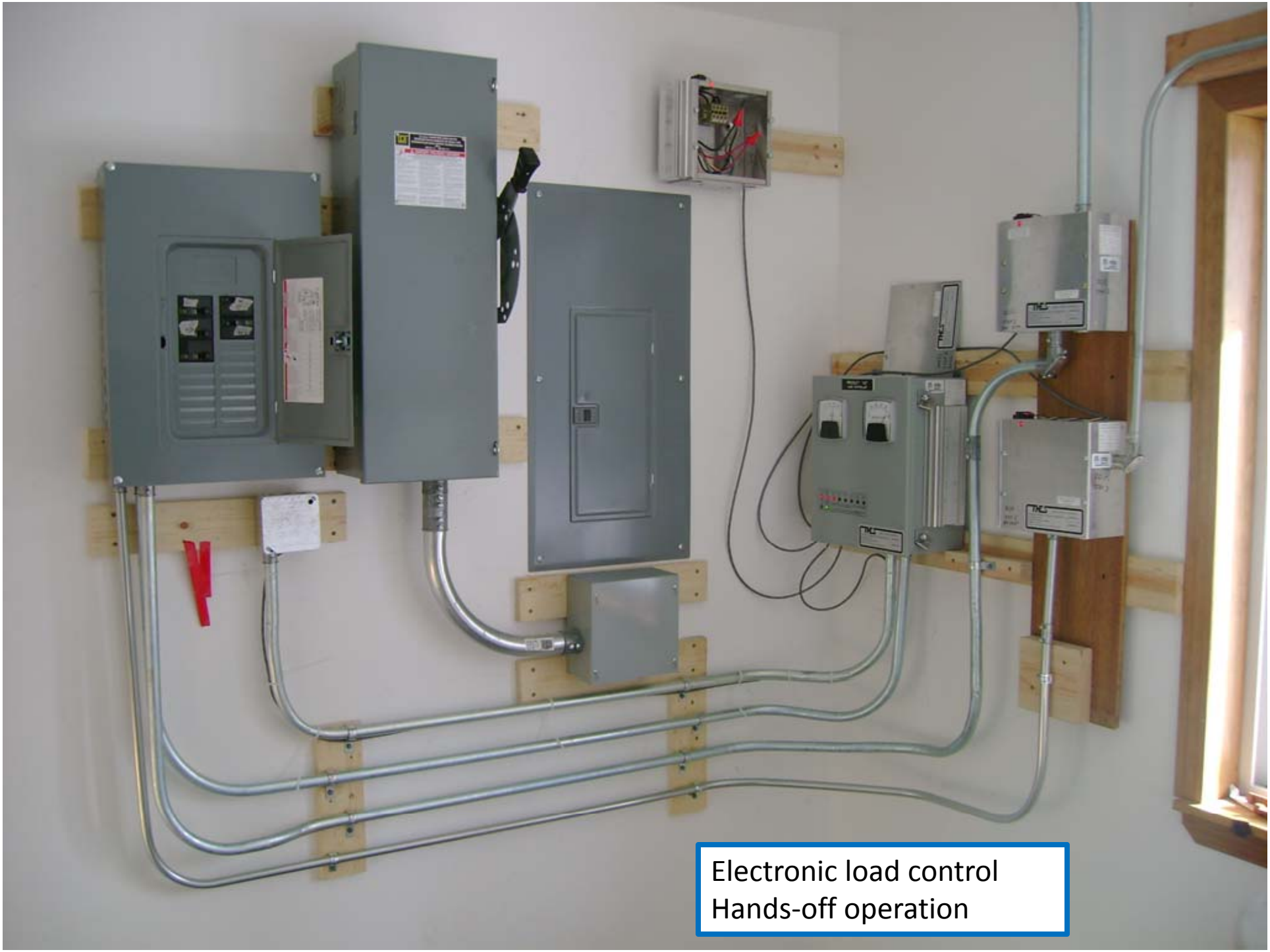
- Installed 2009
- Pelton wheel turbine direct-coupled to AC generator
- 12kW max production, 7.5kW-10kw typical output
- Load-controlled governor system

6” polyethylene pipe

200 feet head of pressure

“Run of the River”
3 ft deep
Dig out twice/year

12kW max power
Domestic water 85psi
Materials cost: $40,000.00

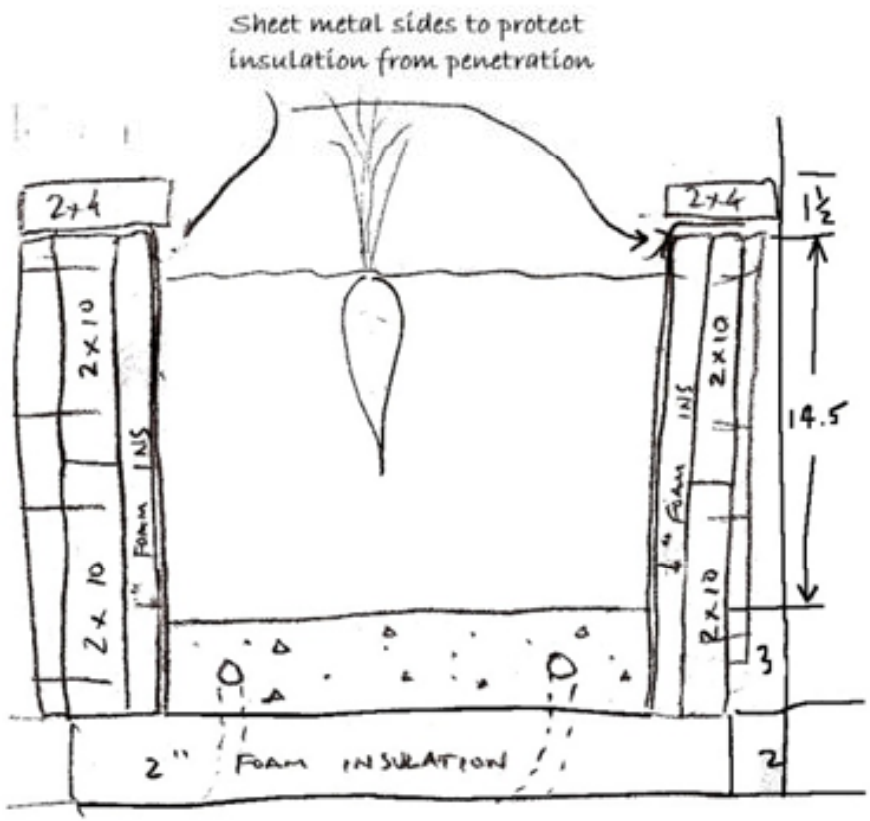

Electronic load control
Hands-off operation

Greenhouse

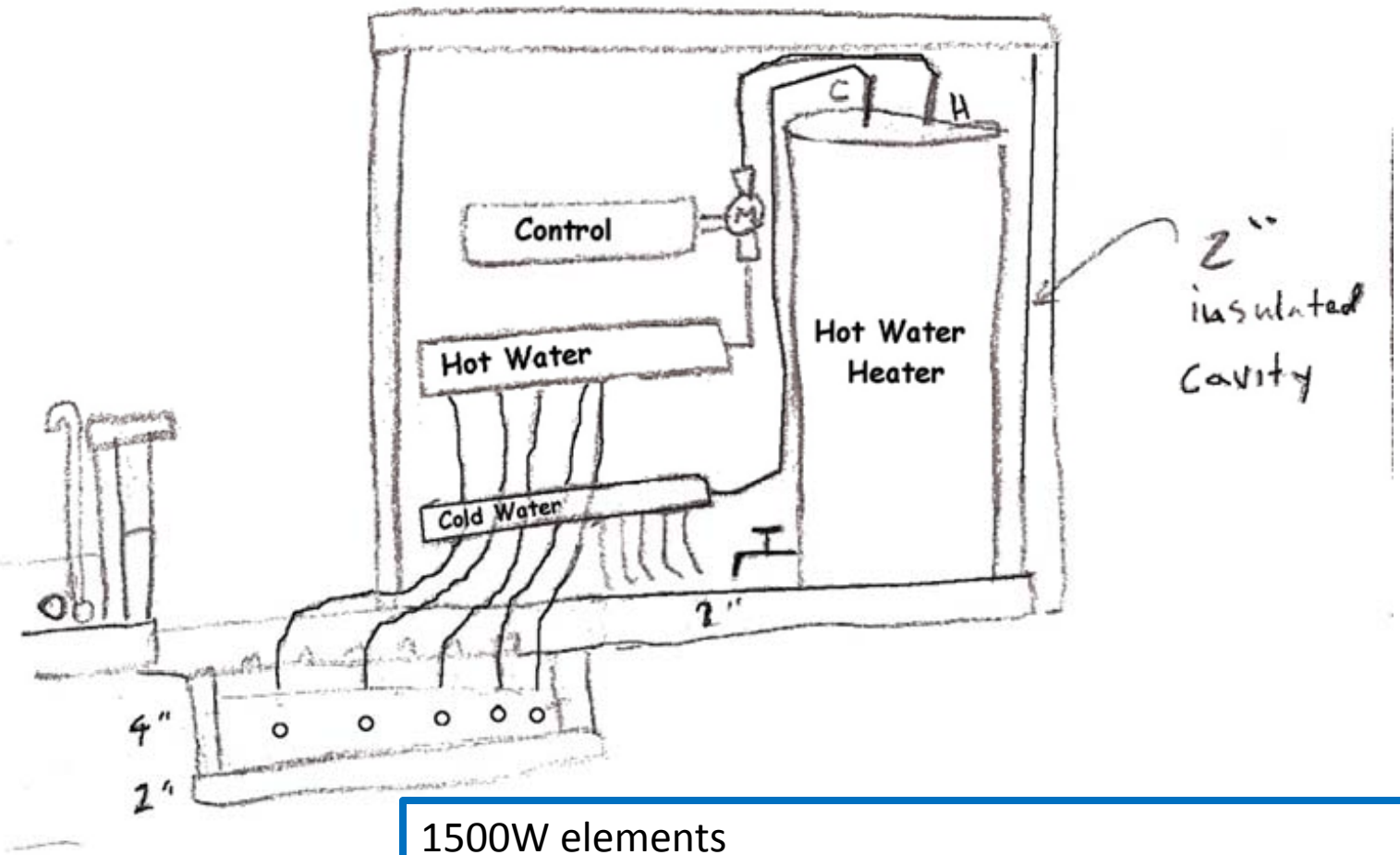
- Exterior built 2009
- State of Alaska Department of Agriculture Innovation Grant for ½ of Project materials
- Heated, lighted beds constructed 2010
- Surface water provided by hydroelectric system

Double-wall polycarbonate sheets
Post-and-beam construction
Haines, AK, snow loads – 110 psf
Exterior trimmed and virtually airtight

Raised bed design



Hydronic heating system design



1500W elements
Standard in-floor heating system design with five zones

All wood surfaces protected

2” polystyrene foam beneath beds

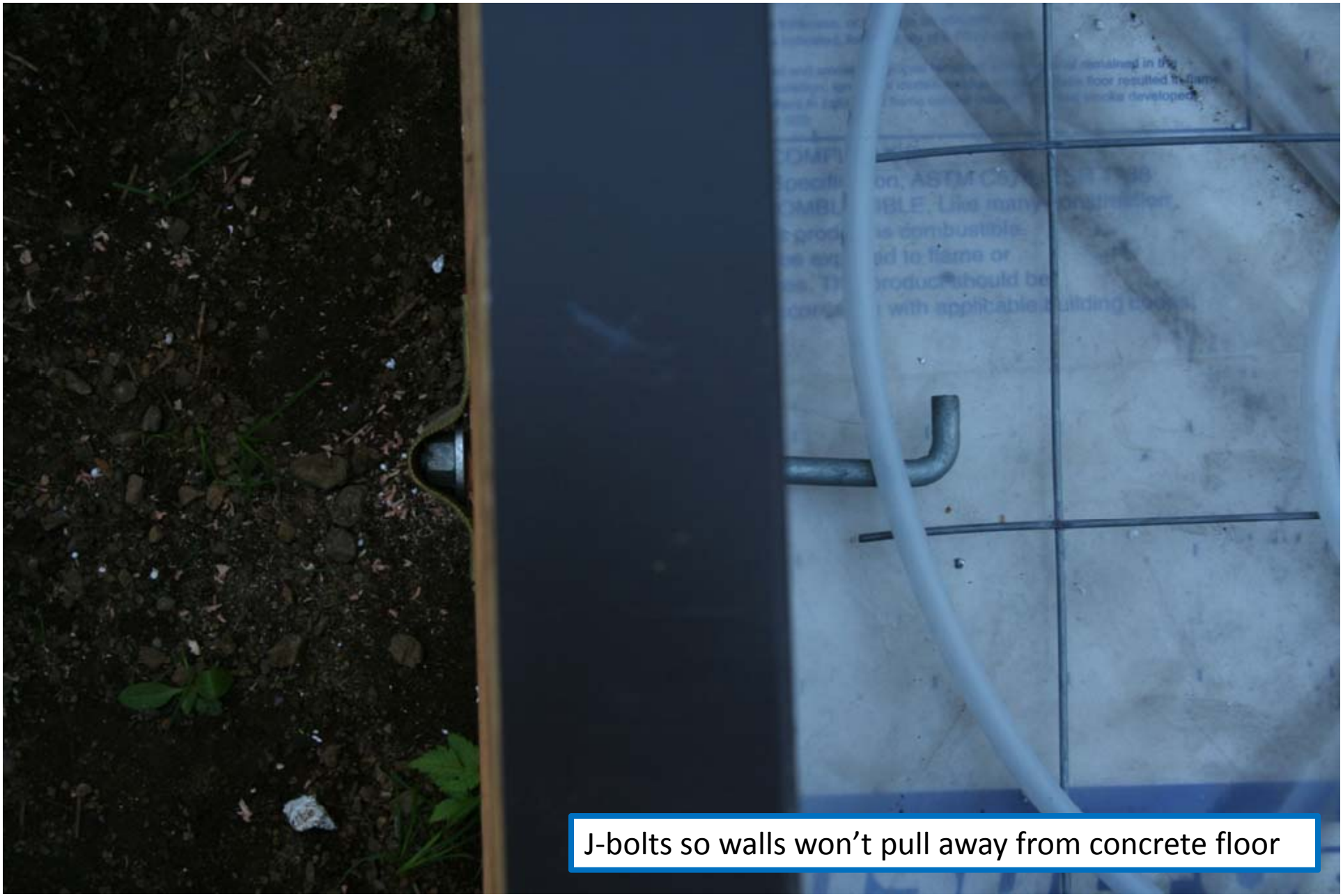
Bed depth accommodates deep root crops

Sides insulated

Pex tubing and thermostat conduit

RIGID INSULATION

R-TECH
Ready for concrete



J-bolts so walls won’t pull away from concrete floor

Quality Control

Fahrenheit
-40
-20
0
20
40
60
80
100
120
120
100
80
60
40
20
0
-20
-40

Concrete Day

94
MUNKRETE

Jackson
PROFESSIONAL TOOLS

Alaska’s secret ingredient

30A service feeds lights, heat, outlets, ventilation

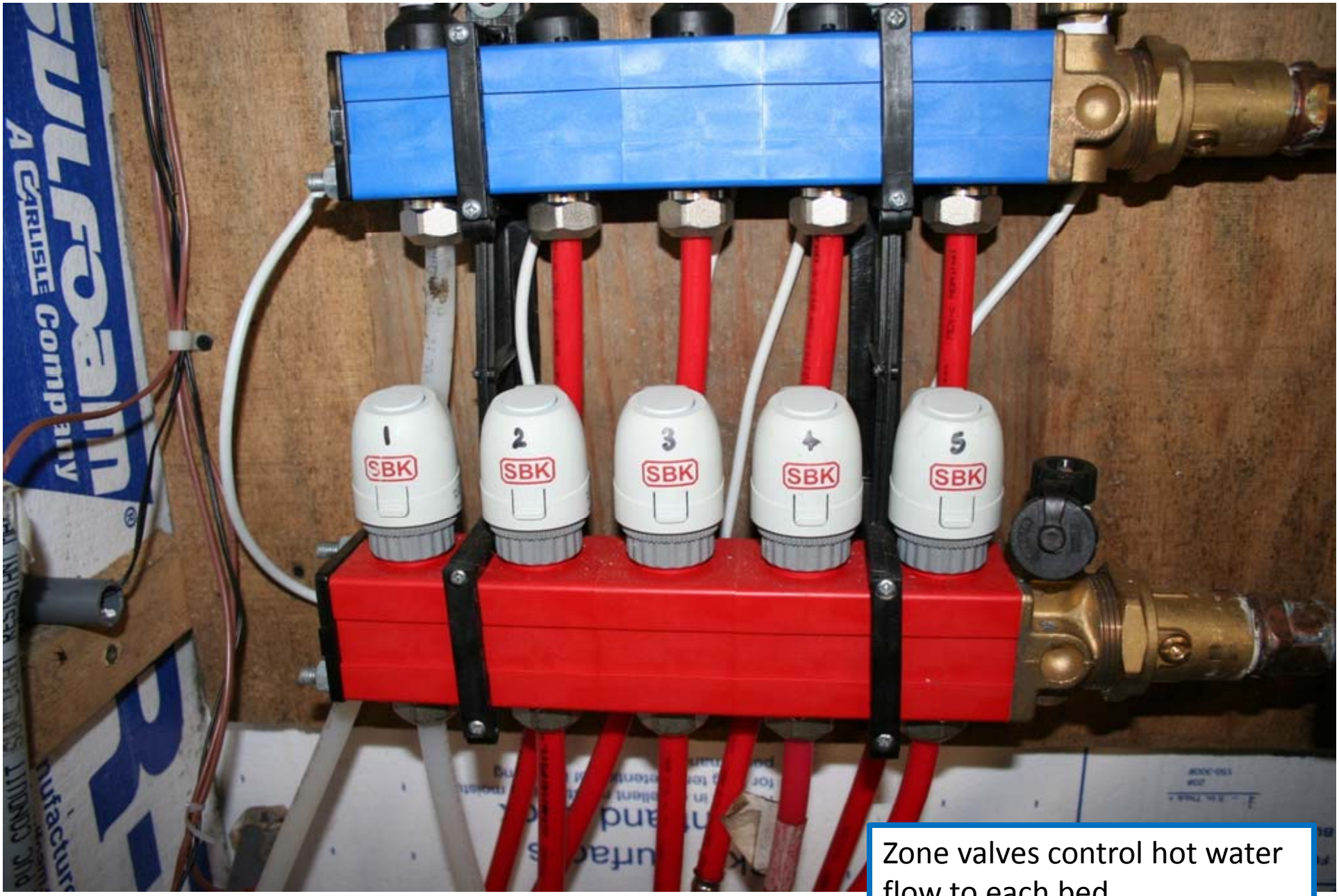
Controls for hydronic syst

Skin
Front
R-TECH
Thoroughly Tested
MOLD RESISTANT RIGID INSULATION
15 PSI

Programmable thermostats display actual bed temps

Thermostat sensor
6” burial depth – the “root zone”

1500W electric hot water heater provides heat for beds



Zone valves control hot water flow to each bed

One bank of lights for each bed

First
planting
Nov 2010

SHARPTEMP
May 14, 2011

May 14, 2011

May 14, 2011

2011 coordination with outdoor garden

- April - Warm-weather crops (melons, peppers, corn, tomatoes) planted in greenhouse beds
- May - cool-weather crops in outside garden
- August- harvest warm-weather crops from greenhouse
- August – plant cool-weather vegetable crops in greenhouse beds
- December- harvest cool-weather crops from greenhouse

2012 planting plan

- March 15 (or as soon as hydro system is up) – suspend starts under lights – plant warm-weather crop seeds in the heated beds
- May 14 – transfer starts to outside garden
- September 1 – harvest warm-weather crops and replant greenhouse beds with food vegetables
- Proposed annual result: one season of warm-weather crops and two seasons of food crops

Results of Greenhouse beds

- Growing season: April through December
- Two crops of vegetables harvested
  - Late summer (warm weather crops planted in April)
  - Late winter (cool weather crops planted in fall)
- Augments outdoor garden with starts in May

Lessons learned so far…

- I’m just beginning to learn
- Light is more significant than temperature for growing most crops (50-55 works) except tropical plants (like melons and tomatoes)
- Ice is very unforgiving
- Automation gives opportunity for more innovation

Planned Improvements

- “Roll-up” gang light adjuster to place lights closer to plants
- Automatic drip watering system – labor saver
- Automatic venting system