An Arizona public housing project for people disabled by environmental sensitivities

This article describes a publicly-funded housing project for people with chemical and/or electrical sensitivities (MCS and/or EHS) near Snowflake, Arizona. The following topics are covered:

- why such projects are needed
- how the project was designed
- how it was built
- experiences after five years

Keywords: MCS housing, low-EMF housing, Snowflake, Arizona, multi-unit housing, OCCAC, Rocking R Ranch, MCS rental, low-income housing, MCS, electrical sensitivity, disability, environmental illness, housing design

Introduction

Persons disabled by multiple chemical sensitivity (MCS) face a severe housing shortage. Due to their extreme sensitivities to formaldehyde, mold, glues, solvents, paints, carpets and many other materials, most regular houses are

unsuitable for these people. A newly built conventional house would probably need at least ten years of offgassing to make the building products tolerable. By then, the building will generally have become contaminated from people living the conventional lifestyle using pesticides, fragrances, laundry products, cigarettes etc. Mold may by then also become a problem to these extremely sensitive people, even in a desert setting.

Some people with MCS also have electrical sensitivities, where they may be affected by very low levels of radiation from household electrical wiring, appliances, fluorescent lighting, electronics, cell phones, etc.

As people with these sensitivities often lose their job, spend their savings on medical treatments and subsist on disability insurance, many patients also face severe financial distress. A purpose-built or renovated safe home is often beyond the financial reach of many people.

Many people with MCS have moved to the Southwestern United States to take advantage of the dry climate with fewer molds and pollen, and air which is cleaner than in most rural areas.

To improve on the severe shortage of affordable housing, the state of Arizona financed a four-unit housing project. It is only the second publicly funded MCS housing project in the United States. The first one is Ecology House in San Rafael, California, which opened in 1994 with eleven apartments, in what has now become a congested urban area.

There are two private projects in Florida and several in Texas. These private rentals command a premium price, which is beyond what most people can afford, even with a regular income.

This appears to be the first multi-unit project in the United States to include low-EMF features to accommodate people with electrical sensitivities.

The Snowflake project

The Snowflake project is located in the high desert of northeast Arizona. The nearest town is Snowflake, about six miles to the west. The area is lightly populated, with little or no industry, agriculture or mining. Nearly thirty people with MCS live in the vicinity, in custom built housing on 20-40 acre individual parcels.

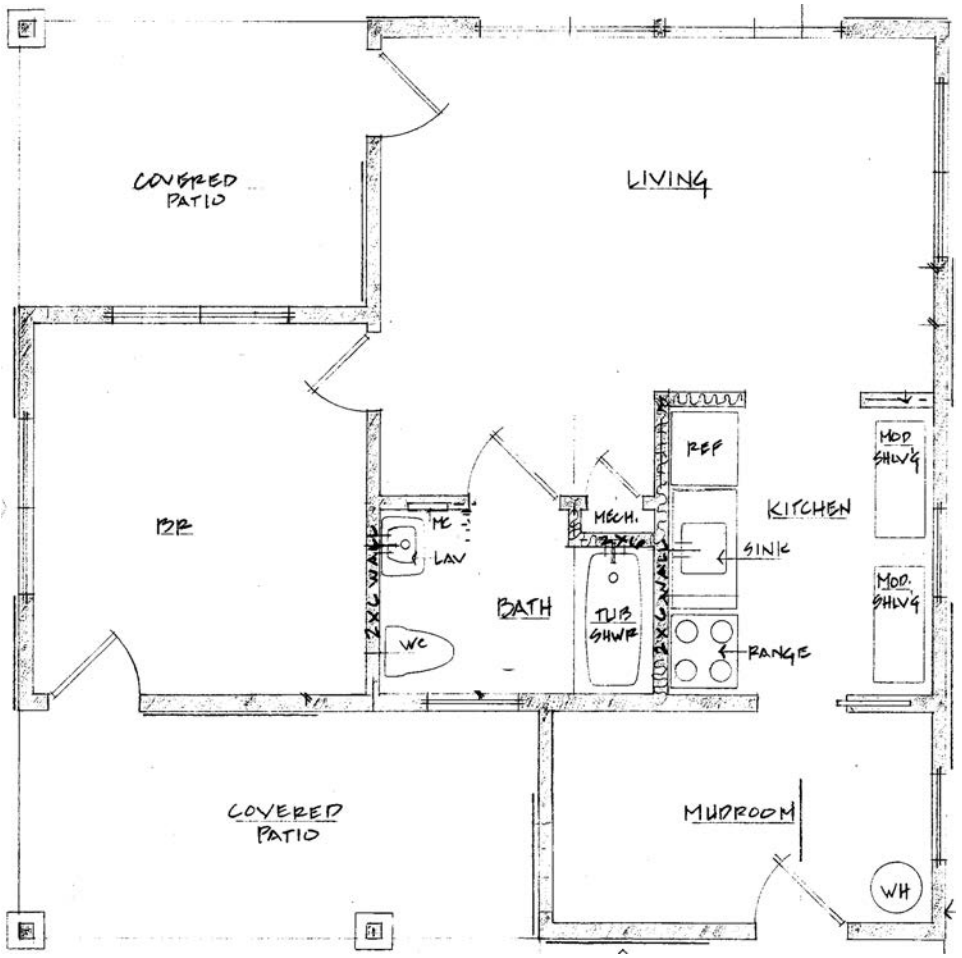
The project became reality because Susan Molloy, a local disability rights activist, had for many years advocated accessible affordable housing for people with disabling sensitivities. The project was financed by the Arizona Department of Housing.

A former organic farm with forty acres of land was purchased. A zoning variance was obtained from the county, to allow a total of five dwellings on the forty acres. The zoning otherwise allows only two dwellings.

To make the five new buildings less obtrusive, they were sited low on a north-facing slope and put close together with 25 feet (8 meters) between each house. This also made a shared heating system feasible.

The aim of the project was to provide housing for low-income people with mild to moderate MCS, and also to include low-EMF features for people with electrical sensitivities.

The one-bedroom design



floor plan courtesy R. Stephen Posey, architect

Three of the houses are one-bedroom units with a total floor space of 760 sq ft (79 m^2). They have a very attractive appearance, with a complex pyramid roof covering both the house and the two porches. A small section of the roof extends over both exterior entry doors.

The overall plan is square, including two patios recessed in corners of the house. Covered patios are important features in MCS housing, as they allow the resident sheltered workspace for tasks that require fresh air, such as small repairs or opening mail. They are also useful for receiving visitors outside, or for simply reading a book, if the ink fumes are a problem. A covered patio can also be used to temporarily store newly purchased items that need to offgas some, before they are taken inside.

In an emergency, such as if the house needed maintenance that contaminates the inside air for awhile, the porch may provide a refuge.

Living room of a one-bedroom house.

The interior of the house is laid out with a large living room overlooking the slope to the north. The large windows and the floor plan make the house feel roomy and cheerful.

A door allows direct access to one porch, while the bedroom, bathroom and kitchen are all off the living room.

The bedroom is placed by itself, with three outside walls, which gives lots of ventilation possibilities. All electrical systems and main wiring is located away from the bedroom, minimizing noises and EMF radiation, which both can be a problem to some people with MCS.

The bathroom has a window to the outside, which is essential for providing natural light and ventilation to combat mold growth. There are sturdy wooden blocks installed in the walls, in case grab bars are needed in the future. All doors have flat thresholds and are wide enough to allow a wheelchair to pass.

The kitchen is conveniently located to the living room and the mud room, with the dining area a part of the living room.

The kitchen does not have installed cabinetry and has limited counter space. Instead, there is chrome wire shelving of a type that is normally moveable, but

here has been fixed with brackets. A moveable stainless steel table provides a work area.

Kitchen cabinets are a challenge in MCS housing, as most are not tolerable. Steel cabinetry is used primarily in commercial kitchens, laboratories and medical facilities and commands high prices. Most are stainless steel, which is expensive. This author is aware of only one usable and affordable brand, which requires custom made countertops.

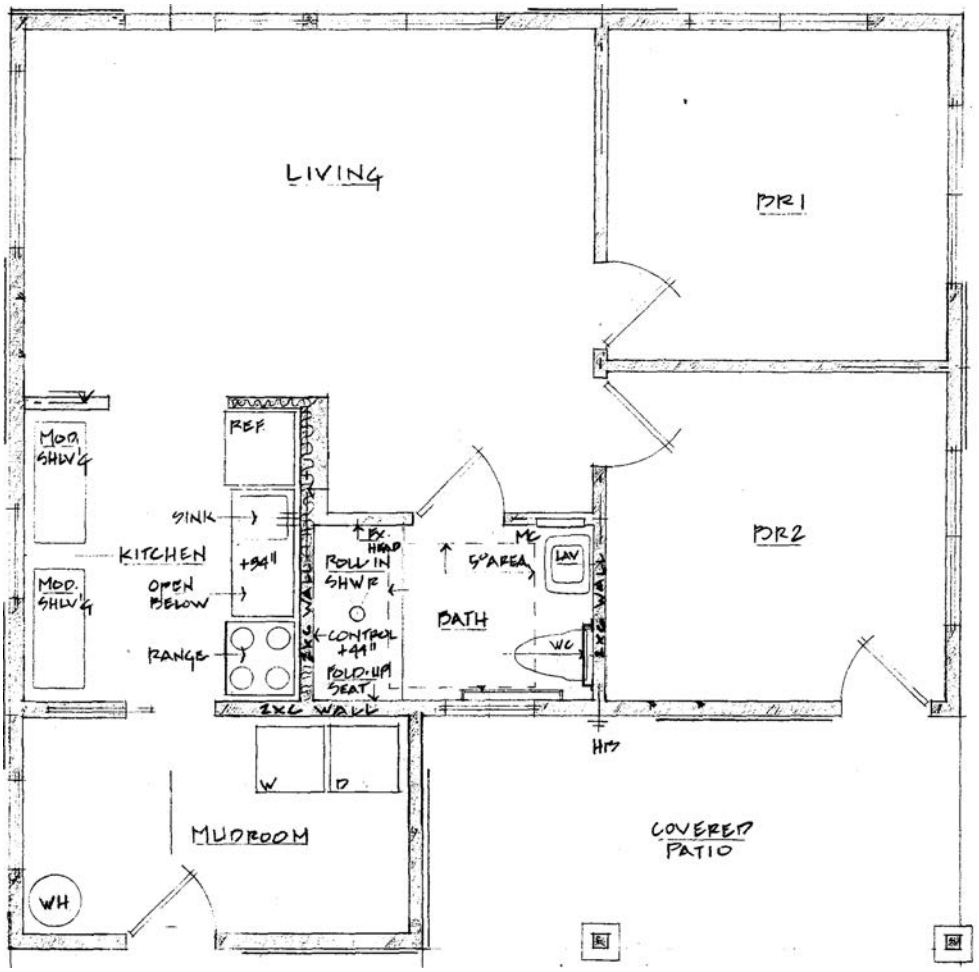
The chrome wire shelving is well tolerated and has the benefit of not gathering dust (important in a dry climate).

The kitchen is located away from the bedroom, which is a nice feature. Many people have trouble sleeping if they hear the noise of the refrigerator, and keeping the EMF radiation away from the sleeping person is also a good idea.

The mud room can be used by the resident to store things that are too odorous to keep in the main house, but not so bad they have to be kept totally outside the house. A window provides ventilation when needed. The specific use of the room will vary with the person, but may include clothes, shoes, files, books and computer equipment.

The mud room has a door to the outside, which can provide extra ventilation, and allow the room to be used as an airlock in case of smoke from a forest fire or other pollution. A pocket door provides access to the house through the kitchen.

The two-bedroom design



floor plan courtesy of R. Stephen Posey, architect

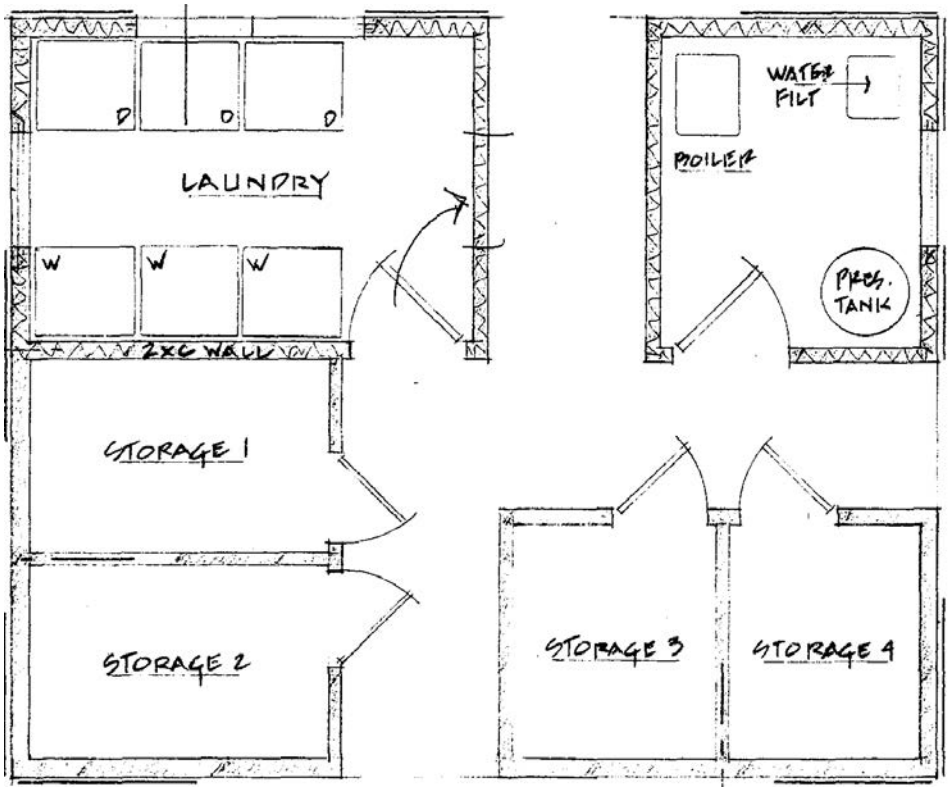
The two-bedroom house is a little larger, with 880 sq ft (92 m^2) of floor space. It is intended to house a disabled person and their family or a live-in caregiver. The house is fully wheelchair accessible.

The overall design and layout is much like the one-bedroom. The two bedrooms are placed next to each other and away from all mechanical and electrical installations.

All doors are wide enough to accommodate a wheelchair. The doorways have flat thresholds, the bathroom has a roll-in shower and several grab bars. The driveway is designed to accommodate a lift-equipped van. The mud room has its own washer and dryer, while the other units share a separate laundry building (see later).

The house has a single covered patio, which is directly accessed from one of the bedrooms.

The mechanical building



floor plan courtesy of R. Stephen Posey, architect

The four houses share a mechanical building, which contains the shared heating system, well system, laundry and storage rooms.

Each unit has a 50 sq ft (5 m^2) storage room with a locking door.

The laundry room has a dedicated washing machine and clothes dryer for each of the one-bedroom houses. The two-bedroom house has its own set in its mud room.

The effluent from the washers is directed to a graywater system next to the building.

A dedicated washer and dryer for each unit is important, as experience shows they are difficult to share. The laundry soap that works well for one person may leave a residue in the machines which then contaminates the next user's clothes. Similar

problems can happen with the dryers. Sharing machines with other people, even when all have MCS, will require strict rules and a high degree of cooperation.

The mechanical building (left) with the water tank and propane tank.

The reason the machines are in a separate building is that the fumes can be troublesome, both from the machines themselves (hot motor parts) and also from the soaps and the clothes themselves.

The drone of the machines can also be a problem for residents who are noise sensitive, which is common among people with environmental illness.

There are rules for acceptable laundry products, as the dryer exhaust often reaches the houses.

The shared well is located next to the mechanical building, which houses the booster pump, pressure tank and water filters. The water filters remove iron and hydrogen sulphide. The filters are backwashed, with the excess water directed to the graywater system.

Each of the four houses has a water filter installed in the kitchen. Some residents have chosen to also install a reverse osmosis filter at their own expense.

Two outdoor storage tanks were installed to meet peak demand. The tanks are standard UV-stabilized polyethylene water tanks, certified for household water use.

The four houses share a central propane boiler in the mechanical building. Despite that the houses are downwind from the chimney, this clean-burning fuel has not been a problem. As long as the burner is well maintained, few residents should have a problem.

Each house is connected to the boiler through a separate underground PEX pipe. Thermostatically controlled circulation pumps in the boiler room direct hot water to each house as needed to maintain an even temperature. The thermostats are set by staff and are not controllable by the renters as in-floor heating systems become very inefficient if the floor is not kept at an even temperature.

This is the best type of heating system for MCS houses. The only viable alternatives would be electric heating of some kind, either with a forced-air heat pump or resistive baseboard heaters. A forced-air system has problems with eventual dust and mold accumulation in the air ducts. The noise, air movement and electromagnetic fields are also problematic to some. Electric baseboard heat is often the better alternative to forced-air systems, though there can still be problems with "fried dust" and electromagnetic fields.

Staff housing

The existing farm house on the property was not chemically contaminated, as the prior owners were organic farmers and did not live the contemporary lifestyle. However, the house was not quite acceptable for MCS housing, so it has been used for staff housing.

The house was originally heated by a wood stove, but was converted to propane heating to avoid the smoke, which is very bothersome to people with MCS. The house is a hundred yards from the rental units, and not upwind of them.

Contractors and supervision

The architect was R. Stephen Posey of Prescott, Arizona. During the design phase, he traveled to the area several times and met with the local MCS community to receive input on the design and materials choices. He also made several on-site inspections during construction.

The contractor had no prior experience with less-toxic housing. Experienced builders were available locally, but did not meet the requirements of the state-

funded project. The lack of a contractor with prior experience does not seem to have been a major problem.

The contractor provided a list of the materials actually used in the project (see later).

The contractor's crews were instructed not to smoke anywhere on site, to prevent contamination of the buildings. There was also a total ban on the use of biocides, pesticides and termiticides anywhere, for any reason.

A list of acceptable cleaning products was provided to the contractors for use during construction cleanup. The listed products were:

- 7th Generation Free & Clear Liquid Soap
- Bon Ami scouring powder
- denatured alcohol

Building materials

The choice of materials is fundamental to the success of an MCS house. This is the case both for the early years and long-term. The materials must be both less toxic and require little maintenance, such as painting.

When people with MCS have a house built, it is customary that they participate in the selection of materials. Experience shows that when given a choice among less-toxic materials, there is no consensus on which brand is the most tolerable. This is particularly the case for caulks and paints. With a multi-unit project, it makes no sense to customize to an individual.

In building projects for a particular person, specific batches of materials may also be tested prior to purchase. Drywall is a common example. This may not be feasible for a multi-unit project, and wasn't done for this one.

Some of the more stringent building methods, such as airtight sealing of the drywall and using grout and thinset made from scratch without additives, were not used in this project.

Even with such precautions, it is standard that the finished house needs to be aired out for months after completion prior to move-in. During this time, windows must be open as much as possible.

These rental units were aimed at moderately sensitive people, not severe cases. To accommodate severe cases would require the more stringent building methods and stricter selection of materials.

This project included the safest, most tolerable materials that are affordable and easily available:

- gravel for the access road was free of asphalt residue
- concrete was free of any additives (freeze protectants, accelerants, fly ash, etc.)
- no termiticide used under foundation — termite shields used instead
- the roof beams are made of laminated wood (okay since outside living space)
- bottom sill plates are redwood (instead of treated lumber), for mold and insect protection
- studs are Douglas fir (instead of pine)
- no fumigants, wood preservatives or anti-microbial treatments of any kind
- the air barrier/house wrap is Tyvec (a regular brand), using Polyken aluminum tape to seal around the edges
- the insulation in walls and attic is blown-in formaldehyde-free fiberglass
- foil-backed drywall was used for walls and ceilings with the foil facing into the wall. The gypsum drywall itself was not sealed towards the interior.
- drywall containing anti-mold treatments ("green board") was not used anywhere
- drywall panels are taped to the concrete sub-floor
- Murco M-100 hypo-allergenic joint compound was used (www.murcowall.com)

- Bioshield Kinderpaint was used, with the requirement of not applying it to damp surfaces or during high humidity conditions (max 85% R.H., no rain, snow or fog) to avoid mold

- caulk specified as "100% silicone without additives." DAP brand was used, some other brands would have been fine, too.

- the siding is metal with a wood pattern, from Quality Edge (gebuildingproducts.com) supplied by All Custom Supply in Taylor, Arizona

- the roof is steel with conventional Feltex roof underlayment and decking

- the floors are ceramic tile with less-toxic commercially available thin-set and grout. The "Custom Blend" and "Master Blend" brands were listed as acceptable.

- window sills are covered with ceramic tile

- walls around shower/tub covered with ceramic tile

- plumbing is copper pipes with lead-free solder

- sewage lines are conventional ABS plastic

- water fixtures do not contain anti-microbial or anti-fungal finishes

- stainless steel kitchen sink and faucets

- windows have aluminum frames. The model with built-in thermal break was specified.

- metal blinds installed instead of curtains

- all doors are steel panel doors

- door frames are poplar wood (instead of pine)

- Bioshield Aqua Resin Trim Enamel and Aqua Resin Stain used on outside wood trim

- Chrome wire shelving instead of regular kitchen cabinets (chrome safer than painted or vinyl-covered steel)

- free-standing stainless steel table instead of kitchen counter

Low-EMF features

The houses were not intended for people with severe electromagnetic hypersensitivity (EHS). Since many people with MCS also have some electrical sensitivities, these houses do incorporate several features that reduce the electromagnetic fields (EMF).

These features include:

- detached housing makes the neighbors' use of electronics less of a problem

- rural location, far from transmission towers

- burial of the electrical lines to the house

- use of twisted wiring inside the houses. This was accomplished by using 3-conductor (12/3) wiring, which happened to be factory-twisted. The extra conductor was left unused.

- locating refrigerator, stove, water heater and electric meter away from the bedroom

- the stove has simple manual (not electronic) controls and no built-in clock

- the heating system is in-floor radiant, instead of electric heat. The pumps and electronics are located in the mechanical building

- the layout allows short direct runs of wiring from the electrical panel to the main electrical consumers (water heater, stove, refrigerator). The wires do not run near bedroom nor living room.

- the electrical panel is located on the wall of a room that is rarely occupied. If wireless "smart" electrical meters are later installed, it may have to be relocated to a pedestal in the yard.

- natural light available in every room, to minimize use of electric light

- operable bathroom window so moisture can be vented without electric fan
- less need for air conditioning through passive cooling design
- electrical outlet in mud room, so refrigerator can be moved there, if necessary
- no fluorescent light fixtures

Passive cooling

The south sides of the houses have very large roof overhangs, which shade he summer sun, and allow cooler air in through the windows. The heavy concrete-slab floor provides thermal mass, which helps even out the hot days and cooler nights. These features make air conditioning less necessary in this high-altitude desert climate where the nights are always cool, especially if the west-facing windows are covered in the afternoon.

Management

The state agency found a local non-profit organization to manage the finished project. This organization had substantial experience managing housing for substance abusers, though had no prior experience with MCS clientele.

Experiences after five years

The houses were completed early 2008, with several people signed up on a waiting list. However, renting out the houses was very slow the first two years. The houses needed to be extensively aired out before they were tolerable and the property manager did not have the resources to open and close the windows. The first renter of each house had to live there while offgassing it, which few were able to do.

The first house was rented out in the spring of 2008. The renter kept the windows open and large fans running throughout the summer, so by fall the house was much improved. With a conventionally built house, the offgassing period would have been several years.

Two lightly sensitive people moved in during 2009. One was a smoker, the other used some odorous products (possibly essential oils). Both renters left a year later, the smoker because of a new smoking ban. The two houses were then contaminated and sat empty for a couple of years, until renters were found who could live there while airing out the houses.

The fourth house saw its first renter in the spring of 2010. The house had been closed up since it was built and still needed to be aired out over the summer.

By 2013 all four houses were well tolerated by most people with MCS, and there is a waiting list of prospective renters. The project is now a great success, but it took awhile.

The houses are also a success for some people with electrical hypersensitivities. In one case, the renter was so severe that the breakers were kept off in most of the house, which worked well with this house design.

The local utility company installed wireless mesh smart meters in the area in 2013. With the meter sockets mounted on the houses, that was a threat to those with electrical sensitivities. The utility company allowed anyone to retain their existing meter, which all residents did. However, the company may later exert financial pressure to get people to convert to a smart meter.

With the houses only 25 ft (8 m) apart, people with electrical sensitivities are dependent on their neighbors to opt out of a smart meter and refrain from using wireless devices, such as cordless phones and wireless networks.

The property manager has complained to the residents about the high heating cost, but the system does not allow metering the individual houses and there is no incentive for the residents to conserve heat.

The storage rooms in the mechanical building have seen limited use, as there are no ventilation holes so they still smell like new construction, even after five years.

The following are suggestions for improvements to incorporate in future projects:

- provision for unattended airing-out of the houses, so the first renters do not have to do the off-gassing
- backsplash protection of the delicate clay-painted wall behind the stove
- reduce size of west-facing windows to reduce afternoon solar heat
- tile all around windows, to deter drywall mold from condensation
- ventilation openings for the storage rooms
- locate electrical meters away from the houses, so wireless smart meters can be used
- increase the distance between the houses to 50 ft (16 m) or more
- meter the heat consumption of each house individually. The meters cannot use wireless or PLC technologies.
- install clotheslines, so the residents can more easily break in new clothes

The two-bedroom house

Acknowledgement

The author wishes to thank Susan Molloy and the architect, Stephen R. Posey for sharing details and history of this project. Some former residents also contributed information.

The author is an engineer who has lived in two multi-unit MCS housing facilities in Texas, and now lives in a safe house of his own design.

2010 (updated 2013)