February 5, 1992

Representative Raymond Short
House of Representatives
State Capitol Building
Salt Lake City, UT 84114

Subject: UDOT Maintenance Buildings (Report No. 92-02)

Dear Representative Short:

In response to your request, we have reviewed the Utah Depart- ment of Transportation's (UDOT) prototypical highway maintenance building for appropriateness of size, cost, and configuration. UDOT has built prototype facilities in Randolph and Kanab, and, according to the most recent five-year plan, would construct 23 more facilities at an estimated cost of $20,378,000 over the next five years. Facil- ities include the prototype building plus other site improvements such as storage shed, fuel station, loading ramp, fencing and paving. In order to report on the prototype building during this legislative session, we have restricted our audit scope to a review of the proto- type itself. We have not reviewed the number and location of main- tenance facilities as was originally planned. However, the Division of Facilities Construction and Management (DFCM) has agreed to hire a consultant to conduct such a study. In this letter report, we present concerns dealing with the two prototypes already built and the prototype design in general.

We found the size of both prototype buildings to be unneces- sarily large for the number of trucks actually housed at those locations. Also, the prototype provides more space per truck than buildings in other states, largely because the Utah design incor- porates a covered drive lane and large work area. Further, the results of a Value Engineering (VE) review conducted on the prototype design estimate as much as $127,000 in cost reductions per building are possible in one

reconfigured design. The VE report also shows that $51,000 in cost reductions per building are possible if features are modified within the prototype design. UDOT has accepted $41,000 of the $51,000 in cost reductions recommended by the VE report. Also, some design features are not used in maintenance buildings in other states, although UDOT administration believes they are needed. Since the drive-through design was implemented without an architec- tural program being done, we believe that a full programmatic re- view of the features needed in a maintenance building should be conducted by DFCM.

Before UDOT proceeds with its five-year building plan, we believe the Legislature should make a policy decision about the prototype. This report identifies three alternatives. First, the Legislature can appropriate funding for maintenance buildings this fiscal year with accompanying intent language requiring that a full programmatic review be conducted before any buildings are built. Second, a programmatic review can be required without funding this year and DFCM would report to the Legislature during the next ses- sion. Finally, the Legislature can appropriate funding for the modified prototype and construction could proceed this year. We believe that new UDOT maintenance facilities clearly are needed. However, we are concerned that the prototype program was initiated without a program review and the two existing facilities were built unnecessarily large.

Background and Development of UDOT's Prototype

The prototypical design was developed in 1989 by an architec- tural firm in response to UDOT's request for changes to a drive- through design the department had used in the 1980s; five prefab- ricated metal drive-through buildings had been constructed in that time frame. UDOT indicated it wanted to increase the durability and longevity of the buildings, increase the slope of the roofs, and improve lighting and ventilation. Because UDOT had already decided that it wanted to continue with the drive-through design, the agency overseeing building requests, DFCM, did not conduct its usual archi- tectural review, (nor had it done so when the drive-through design was first developed in the 1980s). This review would normally include a space needs analysis and preliminary budget as part of an initial conceptual review. Instead, the architectural firm incor- porated UDOT's requested features into the 1980s drive-through design as seen at Riverside, Utah. The Riverside building is a prefab- ricated metal building with a low slope roof, 80 by 125 feet, with angled parking, a large work area and a maintenance bay accessed by a separate door. The current drive-through prototype building is constructed out of insulated, split-face masonry block, with a high-slope split-span roof, large vehicle bays, an enclosed drive lane, separate maintenance bay and a large work area. (Illustrations of the prototype buildings can be found in the appendix: Kanab, 1 and 6, and Randolph, 2 and 5.)

In the drive-through floor plan, trucks enter the building by a door located at one end and pull into angled parking bays along one side. To exit, the trucks back into the center drive lane, then drive out a corresponding door at the opposite side of the building from the entry. The standard size prototype is 125 feet long, and can accommodate 6 tandem axle ten-wheeled trucks or single axle bobtail trucks along one side in angled parking. The small version of the prototype

is 100 feet long and parks 4 trucks in the angled bays. Each building can also accommodate a truck in the maintenance bay. The following figure shows the floor plan of the prototype for the standard, 125-foot long building.

FIGURE I

It appears that the prototype as built at the two sites is rea- sonable in cost per square foot and will be energy efficient. The cost per square foot of the prototype at Kanab is lower than the average cost of six other states' buildings. In addition, an air infiltration assessment done on the Randolph prototype by a State Energy Office engineer shows that the building is energy efficient.

We believe that there are current UDOT maintenance buildings in poor condition which should be replaced in UDOT's building program. We are concerned that some needed facilities have been put on hold during the time involved in completing the Value Engineering review and this audit. However, we have concerns about the prototype as will be seen in the next sections, and believe that these need to be addressed as policy issues by the Legislature.

Prototype Size at Two Sites Is Unnecessarily Large

The maintenance buildings at Randolph and Kanab have been built unnecessarily large for the equipment assigned to them. UDOT admin- istration has acknowledged that a better needs assessment should be developed to ensure that future buildings will be built at the needed size and no larger. An analysis of the trucks used for snow plowing should be the basis for setting the size of the buildings.

Both Randolph and Kanab buildings were built to accommodate more trucks than are kept at the facilities. The Randolph facility (100 feet long) houses two trucks but has a capacity for five, four in angled parking and another in the maintenance bay. The facility is assigned a total of four large trucks, but two are kept at the Laketown substation, leaving only two at Randolph. (The Laketown substation has a four truck capacity.) The Kanab facility (125 feet long) is assigned four large trucks, but has a capacity for seven trucks, six in angled parking and another in the maintenance bay. UDOT personnel have said that when Randolph was built, they over- looked the location of two trucks at Laketown. However, they felt the area might see growth that would require the size of station built and they might need to keep Monte Cristo pass open in winter. Further, Kanab was built 125 feet long because of the possibility of growth in the area which would require a larger facility.

We are concerned that the building at Randolph was built without a review of the location of equipment during crucial winter storage, and that the size of both buildings was determined in part by the undocumented possibility of future growth in the area. Maintenance buildings should be built to accommodate the number of trucks assigned to the facility, but this was not the case at either Randolph or Kanab. Future growth is a reasonable consideration, but if growth is to be used as a determinant for building size, firm documentation of the likelihood of growth should be obtained. We cannot document that such an analysis was done for either maintenance building.

In an attempt to assess the appropriate size of building to be built at various locations, DFCM put together an analysis based on maintenance crew size. Also, in an August 1991 memo to DFCM, UDOT discussed determining the size of buildings by crew size. In part, the memo says that UDOT wanted to "...be able to change the size of the station dependent on the number of men in the crew, i.e., a five man crew would get a 100 foot station and a six man or larger crew would generally require a 125 foot station." We expressed our con- cerns to DFCM about this approach. A better approach would be to use the number of bobtail and ten-wheeled trucks at a site, since the buildings should logically be the size needed to house the equip- ment rather than the staff. We found that in 34 stations out of 78 (44 percent) there were more crew members than trucks at maintenance stations.

Using the number of trucks should assure more smaller buildings, which cost less to build and operate. If number of trucks rather than crew size were the criterion for building size, there would be 7 fewer 150-foot long stations, 1 more 125-foot long station, and 6 more 100-foot long stations. UDOT agrees with our concerns and indicates that in the future the number of trucks at a facility will be a primary criterion.

Prototype Has More Space per Truck
Than Buildings in Other States

Not only are Utah's two prototype buildings larger than necessary to accommodate the assigned trucks, but the square footage per truck is large when compared to maintenance buildings in other western states. The major contributing factor to Utah's total building space is the prototype design with its enclosed drive lane and large separate work area.

We obtained information on maintenance buildings from six nearby states, most with mountainous areas and severe winters. Most use a standard size and layout in their buildings, and these states provide warm storage for sanding and plowing trucks, as does Utah. (Warm storage is considered necessary to provide snow- and ice-covered trucks a place to melt off on cold days.) All provide less space per truck than Utah does. The table below compares relevant size and space information between the prototype building in Utah and a typ- ical building in the states listed.

FIGURE II

The square feet per truck was developed by dividing the total square footage of the floor plan of each building by the truck capacity. The table shows information for drive-through designs in Wyoming and Utah, both of which have mezzanine areas. For the pur- poses of the comparison, mezzanine square footage in any building was not included.

As shown, Utah's prototype has more square feet per truck than the other states' buildings. Utah's prototype (125 feet) also provides more total area than buildings in other states, including one in Nevada with 12 vehicle bays (see the appendix, illustration 4). Further, the figure shows that only one of the other six states (16.7 percent) uses drive-through buildings, but even so the majority of maintenance buildings in Wyoming are the traditional style with

overhead doors and pull-in, back-out bays. Wyoming has built most of its drive-through buildings in one western district with severe weather.

The Drive-through Design Creates a Larger Building

The drive-through style of UDOT's prototype contains more total area because of an enclosed drive lane and a separate work area. As a result, less space is devoted specifically to vehicle storage.

The drive-through design has a lot of area devoted to the drive lane. In the standard prototype, the drive lane occupies 26 percent of the total square footage of the building. UDOT does not favor using the lane for overnight parking because it believes this will impede truck movement and use too much employee time to move vehicles out of the way, but has agreed to park some equipment there to better use this space. Another feature that adds to the total size of the prototype is a work area of approximately 1,000 square feet. UDOT indicated it needs 400 square feet of work area, but the design incorporates 1,000 to keep the building outline rectangular.

Because of the space taken up by the drive lane and separate work area, as a percentage there is less total area available for vehicle storage. The figure below indicates the amount of total area in maintenance buildings devoted to vehicle storage.

FIGURE III

As shown, the prototype designates about 43 percent of its area to vehicle storage, while buildings in other states average 67 per- cent. Even though the Kanab building is larger than other states' buildings, as a percentage it has less space available for truck storage. Since the primary purpose of the building is to house trucks, the design is less efficient in this aspect than the tradi- tional styling used in other states. In response to our concerns, UDOT has recently agreed to park trucks in the maintenance bay over- night and to use the drive lane to park such equipment as loaders and graders in order to use the drive-through's space more efficiently.

Cost Reductions Are Possible to the Prototype Design

The results of a Value Engineering (VE) review of the prototype design show that cost reductions are possible in two ways. First, a reconfiguration of the design was estimated to cost over $127,000 less than the prototype's cost as built at Kanab. Second, without redesigning the building, cost reductions of $51,000 were estimated if features were modified or eliminated; UDOT has agreed to identify and incorporate $41,000 in cost reductions into the prototype. We reviewed a few specific prototype features and cannot verify their need. Some of these features were also questioned by the VE review. Because the VE review showed that some features could be reduced or eliminated from the building without affecting function, and because an architectural program has never been done to consider the needs in a maintenance building, DFCM should conduct a full architectural or program review of the prototype.

Once concerns were expressed about the cost of the two built prototypes, a Value Engineering (VE) review was conducted in May 1991. The VE review was conducted by a group of architects and engineers along with DFCM and UDOT staff for the purpose of gener- ating suggestions which would provide cost savings and improve operations and maintenance functions. The VE report showed that numerous changes could be made to lower the design's cost, from a complete reconfiguration of the design to modifications to the current design.

According to the coordinator of the Value Engineering meeting, the purpose of the review is to provide alternative design and plan- ning solutions to an architectural design that will result in savings without reducing function. The review normally does not seek to

change a design but to improve its value. The coordinator for the VE review told us they normally expect about a 10 percent cost reduction as a result of such a review.

DFCM incorporates a VE review into the planning of a state facility if the budget for the facility is $3 million or more, or if the building will be 30,000 square feet or larger. In the case of the UDOT prototype, the VE review was not done until concerns were expressed about Randolph's and Kanab's costs. DFCM told us the re- view was not conducted in the planning phase because a single build- ing was under the set budgetary limit, even though the concept of a prototype is to build several on the same plan.

A Reconfigured Design Could Reduce Costs

The VE review generated over fifty proposals for modifying various features of the design. Even though a VE review does not normally propose a different design, in this case, an alternate design was proposed for consideration that would reconfigure the building, attach covered storage to one side, and lower the estimated cost by more than $127,000.

The redesign would relocate the maintenance bay to the same side of the building as the parking, and allow 440 square feet of work area between the maintenance bay and the angled parking. In place of the deleted work area and maintenance bay, outside covered storage would be built against the building, using one outside wall. Total square footage would decrease and construction savings would result from attaching the outside storage. UDOT gave this design consideration but felt it did not meet their needs without modification. UDOT required that the design be revised to include a larger work area and a wider drive lane; these changes are of concern to us because they are features that need to be independently verified as necessary in a programmatic review which will be discussed later in this report.

UDOT Has Agreed That Cost Reductions Can Be Achieved in the Prototype

UDOT has agreed to incorporate $41,000 in cost reductions into the prototype design. This is in response to the recommendations in the VE report that suggested making modifications to the prototype design short of redesigning it. A projected initial cost reduction in excess of $51,000 was estimated by the VE team. UDOT has not yet specified which features will be modified or deleted to achieve the savings, but plans to do this when the next building is scheduled to be built.

Value Engineering recommendations fell into civil/site, archi- tectural, structural, mechanical, and electrical areas, with the majority of projected savings in the first three categories. Civil/ site recommendations included connecting covered storage to the building and

moving trailer pads adjacent to the building; archi- tectural recommendations included deleting or modifying the clere- story and upper wall windows, reducing building height, using plain face block in lieu of split face, and deleting painting of interior structural work. Structural recommendations included providing adequate site data prior to design, revising the gage of the roof deck, and reducing the length of exterior windows. Mechanical and electrical recommendations included reducing the length of the trench drain, revising work lights, and reducing main panel size.

We Could Not Document the Need for Selected Features in the Prototype

We looked at some of the features reviewed in the VE study and could not show they are necessary. For example, the prototype building has higher interior clearance than the older drive-through buildings, having been raised two feet to provide more clearance to raise truck beds inside the building. The design also incorporates a work area of 1,000 square feet in front of work benches along the wall opposite the parking area, although most other states do not build separate work areas in their buildings. Further, the current masonry block's outer face, although attractive, adds nothing to the function of the building.

The prototype building has a minimum clear height of 17 feet 6 inches at a point 4 feet from the side walls. UDOT's reason for this feature is to accommodate raising a dump truck bed indoors for under- the-bed maintenance and for cleaning the bed. However, we found little verification that truck beds are raised during winter, espec- ially with the sander units mounted on the beds.

We asked foremen and crew members at UDOT's older drive-through maintenance facilities whether they raise truck beds indoors for maintenance. We found that most did not raise the beds once the sander units were mounted on the trucks. If the beds were raised at all, they were raised only one or two feet, because more than that could damage the salt spreader on the back of the truck. The low- slope roof of the older buildings provides enough clearance for partially raising the beds in the parking area, and the roof in the center of the building provides even more clearance. In fact, we observed the raising of a bed at one facility to ascertain that enough clearance exists. Finally, the majority of other states indicated that once sanders are mounted on the trucks, crew members do not raise the beds. Several also commented that under-the-bed maintenance is done outdoors, even in winter.

The prototype design incorporates a work area of 1,000 square feet in front of work benches along the wall opposite the parking area. UDOT officials have indicated that a separate work area of 400 square feet minimum is required. However, we found that other states do without a separate area by using an empty truck bay if a large floor area is needed for a task. (See the appendix, illustrations 5, 7, and 8.)

UDOT administrative staff told us that the work area is used for tasks such as repairing snow plow blades, changing tires, and repairing road signs, most frequently in spring. Some UDOT field employees told us they repair signs in the work area; others said they used the area but were unable to provide examples of the work done there. One employee indicated they park the foreman's truck there in winter. At another location, we found that a storage room had been built in the work area, thus eliminating much of the floor space. We have found that the described tasks are accomplished in buildings without separate work areas by using empty truck bays. Only one state out of the six we contacted has a separate work area in its maintenance building. This area measures 216 square feet compared to the prototype's 1,000 square feet. Other states use the area in the parking bays between the truck and the wall to work, and use empty truck bays when more floor space is needed.

Finally, a less expensive construction material than the one used is available. The Value Engineering report suggested that using a plain face block could save an estimated $7,800 on each building. The masonry block used in construction of the prototype building is a three-layer block that has a decorative outside layer called split face, a foam insulating core, and a plain cement block inside face. The prototype's exterior color can be changed by specifying different colored split face. For example, the building at Kanab is a red building while the one at Randolph is gray. (See the appendix, illustrations 1 and 2.) Use of the plain face block would save money and maintain the energy efficiency of the prototype.

Other construction materials used in local governments in Utah and in other states are precast concrete tee construction and pre- fabricated steel construction. Although a life-cycle cost comparison between masonry and prefabricated steel construction of the prototype design favored masonry, we are uncomfortable with some of the assump- tions in the analysis. We did not have time to review the life- cycle cost work in depth, but we question the assumption that steel buildings last only 25 years. Other states using steel buildings estimate a 40-year life span, and the buildings are warranted for 20 to 25 years. When we asked for verification of the 25-year life span, the cost analyst told us that he used an accepted standard, but could not provide us with anything in writing.

DFCM Should Conduct a Program Review of the Design

The Legislature should consider requiring a full program review of the prototype design for two reasons. First, we have not been able to verify the need for some of the design features such as the drive lane, large work area, high interior clearance, and the split face block. Second, these and other programmatic features have not been independently reviewed by DFCM. The features in question account for 37 percent of the square feet in the prototype and could affect construction cost significantly if it was determined they could be eliminated. A DFCM architectural program review would look at which features are necessary in a maintenance building and allow those to be incorporated into the building design.

The program review should also consider if a single prototype can meet the needs of the entire state, or whether different UDOT districts have significantly different needs in maintenance facil- ities. For example, the two existing prototypes were built in extremely different climates. While Randolph is often cited as the coldest place in the United States, Kanab has a comparatively mild winter, with warmer temperatures and less snow than the Randolph area. Weather should therefore be a consideration when determining the size of building and features to be included. In severe weather areas, more equipment may need to be stored inside and the roof slope may need to be steep, but in mild climates, these considerations are not as important. Other states told us they do not build prototypes but allow for differences from district to district.

Ideally, an architectural review should have been done when the prototype was first discussed. However, there was no architectural program done when the drive-through concept first came into use in the 1980s, nor was there one done when the prototype design was

derived from that design in 1989. DFCM has not addressed the program or functional issues of the design. Since there were cost concerns raised by the VE review and function concerns raised by this audit, the program issues need to be addressed.

Legislature Needs to Make
A Policy Decision on the Prototype

The Legislature needs to consider what direction UDOT should take with the prototype maintenance building. Since the prototype is scheduled to be built 23 times in the next five years, it would cost over $20 million as modified by VE cost reductions. The cost could increase further if the design is used in the future to replace other buildings, since there are 78 maintenance stations in the state. Options include funding facilities this year with associated intent language to ensure that a programmatic review is done prior to con- struction, requiring a programmatic review without current year funding, and funding the prototype as modified by the VE recom- mendations.

We believe that UDOT needs to replace some maintenance facil- ities. Also, some facilities have been funded in the past but have not been built while the concerns with the prototype have been reviewed. Discussions between our staff and UDOT administration indicate that while we disagree on the necessity of some prototype design features, we agree that the prototype should not be built until evidence is available to identify which features are most cost beneficial. UDOT has preferred the prototype design over other options based on the information provided in life cycle costing analyses. However, some of that data appears to be inaccurate. For example, our energy engineer believes that heat loss due to overhead doors is over-estimated by half. Further, the traditional linear design in the analyses is oversized, with larger bays, larger doors, and more space per truck than seen in UDOT's older buildings or those currently built in other states. In our opinion, a more accurate analysis is needed.

Legislature Has Options Regarding the Prototype

Options are available to the Legislature regarding the funding for the prototype. First, the Legislature can set aside funding for the requested maintenance facilities for fiscal year 1993 with the

intent that the funds will not be used until a full programmatic review is conducted by DFCM. The review would include a comparison of the prototype design with a traditional design using similar construction components (roof and wall material, doors, and so on). The intent language could specify that funding be made available only for cost beneficial features identified as necessary to the main- tenance function. The intent language should be tied to the concerns outlined in this report and the recommendations of the VE review. DFCM would then report the results of the programmatic review to the Legislature during the 1993 session.

Second, the Legislature could choose to ask for a programmatic review without providing any funding this year. DFCM would then report back to the Legislature and decisions would be made on funding next session. However, this decision would prevent any facilities from being built this year.

Finally, the prototype design can be approved and funded as modified by the cost reductions already discussed. If the six facil- ities in UDOT's request are built, the cost will average $886,000 for building plus fencing, paving, storage shed, fuel tanks, and other site improvements. If the 23 facilities are built over the next five years, the expenditure would be approximately $20,378,000. However, building the modified prototype does not address programmatic con- cerns outlined earlier in this report.

Other Savings May Be Possible

Although the scope of our audit was restricted to an assessment of the prototype building, it is important to note that significant costs are involved in what are termed site improvements. More than half of a facility's cost is involved in site work, which includes utility hookups, fencing, paving, excavation and soil compacting if necessary, and the construction of the various other components located in the maintenance station yard. These include trailer pads with hookups, a wash pad, fuel station with underground tanks, a loading ramp, an open storage shed, and a salt detention basin. Several of the Value Engineering recommendations suggest ways to save on these items. We recommend that each of these recommendations be implemented where possible to further reduce the overall cost of a total facility.

Recommendations

1. We recommend that the Legislature make a policy decision on construction of UDOT maintenance facilities, based on one of the following options:

    a. funds can be appropriated for fiscal year 1993 with accompanying intent language requiring that a full programmatic review will be conducted before any buildings are built;

    b. a programmatic review can be done without funding this year and DFCM would report back to the Legislature next session when funding decisions would be made;

    c. the modified prototype can be funded and construction proceed this fiscal year.

We hope this letter has provided the information you need on this issue. A letter of response from the Utah Department of Transportation is attached. If you have any questions or need additional information, please contact us.

Sincerely,

Wayne L. Welsh, CPA
Auditor General

WLW:LSM/lm

APPENDIX