PRE-DESIGN STUDY OF A MODEL IAQ HEADQUARTERS FACILITY FOR THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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ABSTRACT

In 1988, the U. S. Environmental Protection Agency (EPA) commissioned a Pre-Design Study for its proposed new headquarters facility An indoor air quality component was added to the study after employee complaints and public protests following installation of new carpets in the Agency's headquarters building. The new EPA facility was to be a model of good indoor air quality (IAQ). The Pre-Design Study was revised and expanded to include IAQ considerations and requirements. The projected new facility has not been constructed, but many of the IAQ elements of the Pre-Design Study have been used in the design and construction of other "healthy buildings."

INTRODUCTION

During early 1988, the U. S. Environmental Protection Agency (EPA) was planning the construction of a new headquarters facility in Washington, DC. A Pre-Design Study (PDS) was prepared to specify EPA's special requirements that were distinct from the "standard" federal government office building requirements. At that time EPA was expected to become a Cabinet level agency, thus enhancing its prestige and role. It was determined that the new facility should reflect the anticipated enhanced stature and EPA's mission of environmental protection. Therefore, the PDS was commissioned to specify the special characteristics of the building. The PDS report was to be incorporated in a "Solicitation for Offers" (SFO), an open request for private developers to submit bids (design and cost proposals) meeting the requirements and specifications of the SFO.

As early as 1981, the EPA headquarters building's indoor air quality (IAQ) problems were discussed on a National Public Radio broadcast (1). In the Spring of 1988, when the PDS was nearly complete, installation of new carpets in the agency headquarters at Waterside Mall was followed by numerous and employee reports of "sick building syndrome" symptoms. IAQ at the EPA building then received considerable attention from its own employees, the press, and Congress due to events associated with the carpet installation. Because of the employees' concern about the building's impact on their health and comfort, there were public protests and much media coverage including national television and radio. The IAQ legislative proposal being considered by the Congress was then amended to require that EPA's new facility be 'a model of good IAQ.' It was in this context that EPA decided to add IAQ considerations to the PDS. This paper summarizes some of the key IAQ provisions of the PDS, especially those aspects that were particularly important or unique to the EPA Headquarters Facility Project.

Problem Definition

The IAQ requirements development was to address several rather stringent directives. These derived from the requirements for the building to be a "model of good IAQ." There was considerable awareness of IAQ issues among EPA headquarters staff, and it was clear that the new facility had to have indoor air quality that was as low as possible in air concentrations of toxic and odorous substances. Some EPA employees apparently had become sensitive to airborne chemicals. The overall mandate of the IAQ-related additions to the report was described in the "Introduction" to Section C2.4, Indoor Air Quality (IAQ) Requirements:

> "EPA desires a facility for its headquarters which serves as a model of good building practice in indoor air quality design and operation. This section of the pre-design documentation is intended to define the building characteristics which must be achieved in order to provide indoor air quality acceptable in terms of health and comfort to EPA. It is also the intent of the Agency that IAQ be achieved without sacrificing other important aspects of the new Headquarters Facility design. EPA recognizes that if its new headquarters is to establish a model for good IAQ, it must provide a facility which is functional, economical and of high aesthetic quality. The IAQ section is organized to correspond to the design and construction process (2).

The consultants were instructed that the building should not only meet current ASHRAE requirements but also those of all future ASHRAE standards -- obviously an impossible task since the content of future standards could not be predicted. The direction to meet ASHRAE standards, while unrealistic, indicated the importance of IAQ and the seriousness of EPA's intentions. Although ASHRAE had not formally completed the adoption process for Standard 62-1989, "Ventilation for Acceptable Indoor Air Quality," the Public Review Draft clearly indicated the most important requirements. ASHRAE granted permission to utilize the most current draft in as part of the SFO whenever it might be issued.

An important factor in the development of the IAQ requirements in the PDS was that the project was to be built under the "design/build" process. In this process, a developer proposes to construct a complete project of his own design at a stated price. The SFO, including the PDS requirements, were to be the basis for design/cost proposals from such developers. The government would then select a developer and award a contract on the basis of the quality of the proposed building and the price for which it was being offered. After the contract is awarded, in such situations, there is a strong motivation for the builder to attempt to minimize construction costs by designing and installing the most economical building materials, products, and systems. In this process, IAQ is often compromised.

When the addition of the IAQ considerations began, the PDS contained no emphasis on IAQ considerations. The building project defined in the PDS lacked any specific attention to selection of healthy building materials, provision of minimum outside air as required by the Public Review Draft Standard 62-1981R that eventually was adopted as Standard 62-1989, or other essential elements for a building that would be a 'model of good indoor air quality.'

METHODS

The existing draft PDS draft was reviewed by the IAQ consultants, and recommended modifications were made in various sections. A separate, section on indoor air quality

considerations was developed and added to the document. The major sub-sections of the IAQ section addressed outdoor air quality, building site design, overall building ventilation approach, operable windows, low-emitting materials selection, ventilation effectiveness, construction procedures, maintenance considerations, and other aspects of healthy buildings. Many of these elements have been discussed previously in (3), (4), (5), and references therein. Following are quotes and summaries of language contained in the PDS IAQ Section.

"The general office minimum ventilation rate is 20 cfm/person. This refers to the quantity of outside air actually delivered to the breathing zone. It will require a larger quantity at the building intakes to compensate for ventilation efficiency below 100%. 20 CFM is the required minimum quantity of outside air under conditions of minimum outdoor air supply."

"It is important to note that the minimum outside air requirements in the ASHRAE standard are predicated on an indoor environment that is free of significant sources of pollution. The presence of unavoidable sources will require a higher quantity of outside air supply. Thus, the HVAC system must be capable of providing and sustaining higher outdoor air supply rates."

"Emphasis on maintenance of ventilation system equipment is presented in terms of 'readily maintainable' installations. This is a change from earlier language which read 'readily accessible'."

"Outside air supply: The HVAC system design must reflect the anticipated ventilation efficiency as the basis for assumptions which result in the sizing of equipment which impacts outside air supply quantities."

"Sensors shall be provided to detect the quality of outdoor and indoor air such that their output can be integrated into the Environmental Control System logic. Monitoring will be performed on an on-going basis and results shall be used to evaluate and modify building operational and maintenance practices. The offeror shall submit a monitoring plan which may be integrated with the ECS air quality sensors or may be a partially or completely distinct system."

"Available technology to clean air to meet all present and imminent EPA standards and ASHRAE guidelines for ambient and indoor air quality must be employed as required by local conditions. Cost effective removal of some gaseous contaminants and very small particles not removed by conventional building air filters must be utilized for both outdoor and recirculated air to control contaminant levels."

"The trade-offs between cleaning or recirculating return air and conditioning outside air vary greatly from time to time. The HVAC system and Environmental Control System must be capable of detecting critical factors which will allow the automatic selection of the most cost effective mix of air cleaning, outside air supply volume, and recirculated air. The critical factors are the thermal properties and contaminant contents of both the outside air and the return air relative to the design conditions. IAQ monitoring shall be used as input to the facility Environmental Management Control System: possible chemical sensors include carbon dioxide, Volatile Organic Chemicals (VOC), and occupancy sensors might be infrared. The Offeror's proposal shall include consideration

of the impacts of such design, equipment and operations; the Offeror shall not include the cost of the monitoring system in the proposal."

Outside Air Contaminants: "At a minimum, air cleaning devices must be provided which are capable of removing outdoor pollutants which periodically exceed established standards [National Ambient Air Quality Standards (NAAQS) and Table C-1, Ambient Air Quality Guidelines, from the proposed ASHRAE Standard 62-1981R]. This is expected to involve the provision of air cleaning beyond the usual extended surface particulate filters used in most commercial buildings currently. Precipitation, adsorption and scrubbing may also be required by local conditions to provide outdoor air supply of acceptable quality."

"*Recirculation Air Contaminants*: Furthermore, additional air cleaning technologies must be used if necessary to achieve acceptable indoor air quality where recirculation air contaminant levels result in supply air quality problems."

Space Air Distribution: "This method of indoor contaminant control presents a large potential for significant improvement in ventilation efficiency, and thereby, in indoor air quality. Poor ventilation efficiency results in deterioration of indoor air quality and increased operational costs. EPA requires that the Offeror's proposal address the ventilation efficiency of the system during development of the design as well as during construction, commissioning, and initial occupancy." [This was intended to stimulate proposals for occupant controlled personal air supply at the breathing zone level.]

"EPA will require that ventilation efficiencies exceed 80% in no less than 90% of the osf [occupiable square feet] in its new facility."

Energy Management: "EPA desires an energy efficient building employing the latest technology and concepts in building design, construction and operation. Acceptable indoor air quality is a firm base upon which energy management strategies may be developed."

"*Commissioning*: Air balance must include complete system balancing under heating, cooling and economizer cycles. Limitations imposed by weather conditions shall be overcome by completion of the balance work at the earliest available opportunity."

Training Programs: "Offeror must assure that effective training programs will be included in control system and HVAC equipment construction contracts. They must prepare operating personnel to perform routine and extraordinary tasks required of them in the operating the new building."

"Offeror will be responsible for achieving the 'habitability' of the completed facility. Evidence that the facility's ventilation system is fully functional and that air quality is acceptable prior to initial occupancy, will be required. This will be accomplished through 'performance testing' during or immediately after the 'commissioning' of the completed facility. While no specifics for performance verification are included in the proposed standard, it is the intent of EPA that the actual facility be measured prior to occupancy and periodically after occupancy to determine IAQ conformance to ASHRAE (and other applicable) requirements."

Additional Requirements

A "bake out procedure" was included, although the consultants did not recommend it. However, EPA facilities staff determined that it should be included. Cautions regarding the use of the bake-out procedure were included stating some of the potential hazards of the use of a bake-out process.

Material selection: Extensive requirements for evaluation of materials were included, although the design-build nature of the project limited the potential degree of control that EPA might be able to exercise. The requirements specified the offeror's responsibility to submit information relevant to the potential indoor air impacts of selected materials, and EPA reserved the right to review and approve materials on the basis of the submitted information. Emissions test reports were required for critical materials. Details were similar to those in references (3) and (5).

Air quality sensors: It was recommended by the IAQ consultant that EPA issue a separate "request for proposals" to obtain a contractor for air quality sensors. The sensors would be leased by EPA, and the main EPA Headquarters Facility SFO would include the electrical wiring to connect the sensors to the building energy management computer. The sensor contractor would define the performance of the sensors in terms of the substances that would be measured, the accuracy and precision of the measurement, and the cost. EPA would contract for the data input and not be responsible for the maintenance and calibration of the sensing devices. This was recommended to stimulate private industry competitive development of the sensor equipment while avoiding committing EPA to a large investment in unproved devices.

Operable Windows: EPA staff determined that operable windows would be provided, but it was not intended that office occupants would be able to open them at will. However, it was decided to specify installed sensors so that window opening could be detected and adjustments in mechanical system operation could be made if required by a subsequent change in policy.

Special Exhaust Ventilation: The electrical requirements included provision of an outlet capable of handling a large copier machine in each 100 m^2 of open office area. While it was not planned to install the copiers at every outlet, the possibility existed. Therefore, it was recommended that an exhaust ventilation duct be installed in a location accessible to the outlet locations and that a "stub-out" be installed to enable connection of an exhaust duct to handle copier emissions, if required.

RESULTS

No Solicitation for Offers was ever issued, and the proposed facility was not constructed. Therefore, it is not possible to evaluate the results of the recommended IAQ provisions.

The contents of the PDS addressing IAQ concerns are relevant as examples of efforts to direct design and construction efforts toward production of a healthy building. Many of the provisions of the study have served as guidance in other federal government projects and other public and private building projects throughout the country including some EPA regional offices .

DISCUSSION

This paper is intended to provide the reader with the benefit of the work that was performed in anticipation of the "model IAQ" facility's construction. Many of the key IAQ provisions of the PDS are summarized above. There were several areas of needed research and development activities to make design and construction of a healthy building more practicle, but very little progress has been made on most of them since 1988.

The development of special provisions to address indoor air quality at EPA followed considerable publicity surrounding the carpet installation. It is not unusual in our experience for public and private organizations to ignore indoor air quality until such an incident occurs, or complaints and law suits are filed. There is still a lack of other motivation potent enough to raise public and professional concern about indoor air quality.

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