Executive Summary:

The West Oaks location of LA Fitness is a 45,000 sf exercise facility located in Houston, Texas. The focus of this report is to critically analyze the mechanical systems of that building and to implement the best system design. The best system design will be selected as such based on these three design criteria: low energy consumption, reduced emissions, and economic feasibility.

Air System Design:

The building's original design documents suggest that the best way to deliver air to the building is through the use of single zone packaged rooftop units. These are constant volume units, and they are fueled by natural gas. It is quite difficult to find a less expensive system to meet the cooling loads than the one initially proposed. The results from the different unit configurations are shown in Table 0.1 below. The results show that the best way to meet the design criteria will be a modification of the original rooftop units instead of implementing a hydronic alternative.

Criteria	Energy	Economics		Emissions			
Configuration	Consumption (kWh)	First Cost	Annual Cost	Particulates	SO_2	Nox	CO_2
RTU with Desiccant Modifications	935,053	$563,662	$46,771	183	1935	2178	883154
Packaged RTU Design	1,255,859	$419,000	$62,818	166	1937	2589	1099593
Water-Cooled Chiller	843,084	$433,345	$65,761	546	6347	3682	1068328
Air-Cooled Chiller	1,018,379	$427,990	$79,434	625	7266	4215	1222938

*RTU = Original Rooftop Unit Configuration

**Emission Data is in lbm/yr

Table 0.1 – Air Side System Comparisons

In the modified rooftop unit design, all of the outdoor air for the building is sent to one unit where it is preconditioned by a desiccant wheel and a sensible wheel working in tandem. The dehumidified air is then ducted to the rooftop unit's outdoor air intakes where it is mixed with return air and sent to the direct expansion coils for cooling and possibly more dehumidification.

Hot Water Design:

Three different types of solar collectors were studied to see if the existing water heaters' natural gas usage could be reduced with the aid of solar energy. A glazed flat plate solar collector proved to be quite effective at reducing gas usage. This option has an attractive payback period for the site, and it is included in the final design.

Technology	Model	Energy Delivered Per Year (MMBtu)	% Demand Per Year	First Cost	Payback Period (Years)
Glazed Flat Plate Collector	Heliodyne Gobi 408	33.94	53.6%	$5,589	5.3

Table 0.2 – Solar Collector Used in Final Design