

for example, chemical supplier announcements or other actions affecting supply or use.

"After the 1998 effective date of the basic standards and before the effective date of the non-HCFC standard as stated in (1)–(3) above, each manufacturer may annually produce non-HCFC units subject to the alternative standard for up to 5% of its total production or for 10,000 units, whichever is less. This allowance to apply the non-HCFC standard to a small number of units allows manufacturers the ability for field testing with real consumers under actual commercial conditions which will be necessary in the case of the advanced technology which will be required to meet the 1998 standards." (Joint Comments, No. 49 at 21).

As discussed earlier, because of the uncertainty of the availability of HCFC-141b replacements with equivalent thermal properties, the Department has decided to develop new product classes for products that do not use HCFC-141b or other HCFCs in the foam insulation. However, the timetable for adoption of HCFC-free standards proposed by the Joint Comments differs from that proposed by DOE in this NOPR.

#### IV. Analysis

##### A. Engineering—Technical Issues

##### 1. Efficiency Levels Analyzed

The Department conducted engineering analysis of those classes of

refrigerator products for which performance and cost data could be obtained. The classes analyzed were: Top-mounted refrigerator-freezer with auto defrost, top-mounted refrigerator-freezer with auto defrost and through-the-door features, side-by-side refrigerator-freezer with auto defrost, side-by-side refrigerator-freezer with auto defrost and through-the-door features, bottom-mounted refrigerator-freezer with auto defrost, upright freezer with auto defrost, upright freezer manual defrost, chest freezer manual defrost and compact refrigerator-freezer manual defrost. Data was collected by surveys of the industry, extensive literature review and discussions with experts. This information was used as the basis for determining the improvement in performance and the manufacturer cost for each design option added to the baseline unit. The engineering analysis determined the annual energy use, life cycle costs and pay back periods for each combination of design options. Proposed standards for classes which could not be analyzed, due to the lack of data, have been based on the percentage in performance improvement over current standards determined for a similar class that was analyzed. (See TSD, Chapter 3).

The combination of design options which results in the most performance improvement technologically feasible is call the "max tech" design level. Table 2 presents the max tech performance

levels expressed as annual energy use for all analyzed classes of refrigerator products.

TABLE 2.—ANNUAL ENERGY USAGE FOR REFRIGERATORS, REFRIGERATOR-FREEZERS, AND FREEZERS AT MAXIMUM TECHNOLOGICALLY FEASIBLE LEVELS

| Product class                                                | Annual energy use (kWh/yr) |
|--------------------------------------------------------------|----------------------------|
| Refrigerator-Freezers:                                       |                            |
| Top Mounted Auto Defrost .....                               | 422                        |
| Top Mounted Auto Defrost with Through-the-Door Feature ....  | 517                        |
| Side-by-Side Auto Defrost .....                              | 502                        |
| Side-by-Side Auto Defrost with Through-the-Door Feature .... | 516                        |
| Bottom Mounted Auto Defrost ..                               | 444                        |
| Freezers:                                                    |                            |
| Upright Auto Defrost .....                                   | 484                        |
| Upright Manual Defrost .....                                 | 278                        |
| Chest Manual Defrost .....                                   | 284                        |
| Compacts: Manual Defrost Refrigerator-Freezer .....          | 260                        |

The Department selected the max tech level and three other levels from the engineering analysis for further examination. Table 3 presents the four efficiency levels selected for analysis for the nine classes of refrigerator products analyzed Level 4 corresponds to the highest efficiency level, max tech, considered in the engineering analysis.

TABLE 3.—STANDARD LEVELS ANALYZED FOR REFRIGERATORS, REFRIGERATOR-FREEZERS, AND FREEZERS—ANNUAL ENERGY USE (KWH/YR)

| Product class                                                 | Baseline                         | Level 1                          | Level 2                          | Level 3                          | Level 4                          |
|---------------------------------------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Refrigerator-Freezers:                                        |                                  |                                  |                                  |                                  |                                  |
| Top Mounted Auto Defrost .....                                | 397 + 14.2 AV<br>(397 + 0.50 av) | 275 + 9.8 AV<br>(275 + 0.35 av)  | 270 + 9.7 AV<br>(270 + 0.34 av)  | 260 + 9.3 AV<br>(260 + 0.33 av)  | 239 + 8.5 AV<br>(239 + 0.30 av)  |
| Top Mounted Auto Defrost with Through the Door Feature .....  | 462 + 13.0 AV<br>(462 + 0.46 av) | 362 + 10.2 AV<br>(362 + 0.36 av) | 330 + 9.3 AV<br>(330 + 0.32 av)  | 321 + 9.03 AV<br>(321 + 0.32 av) | 300 + 8.5 AV<br>(300 + 0.30 av)  |
| Side-by-Side Auto Defrost .....                               | 609 + 5.8 AV<br>(609 + 0.20 av)  | 514 + 4.9 AV<br>(514 + 0.17 av)  | 429 + 4.1 AV<br>(429 + 0.14 av)  | 415 + 4.0 AV<br>(415 + 0.14 av)  | 402 + 3.8 AV<br>(402 + 0.14 av)  |
| Side-by-Side Auto Defrost with Through the Door Feature ..... | 484 + 12.1 AV<br>(484 + 0.43 av) | 405 + 10.1 AV<br>(405 + 0.36 av) | 353 + 8.8 AV<br>(353 + 0.31 av)  | 336 + 8.4 AV<br>(336 + 0.30 av)  | 312 + 7.8 AV<br>(312 + 0.27 av)  |
| Bottom Mounted Auto Defrost .....                             | 579 + 5.6 AV<br>(579 + 0.29 av)  | 476 + 4.6 AV<br>(476 + 0.16 av)  | 419 + 4.1 AV<br>(419 + 0.14 av)  | 393 + 3.8 AV<br>(393 + 0.13 av)  | 359 + 3.5 AV<br>(359 + 0.12 av)  |
| Freezers:                                                     |                                  |                                  |                                  |                                  |                                  |
| Upright Auto Defrost .....                                    | 399 + 14.2 AV<br>(399 + 0.50 av) | 349 + 12.4 AV<br>(349 + 0.44 av) | 321 + 11.4 AV<br>(321 + 0.40 av) | 288 + 10.3 AV<br>(288 + 0.36 av) | 254 + 9.1 AV<br>(254 + 0.32 av)  |
| Upright Manual Defrost .....                                  | 275 + 8.6 AV<br>(275 + 0.30 av)  | 241 + 7.6 AV<br>(241 + 0.27 av)  | 187 + 5.8 AV<br>(187 + 0.21 av)  | 172 + 5.4 AV<br>(172 + 0.19 av)  | 158 + 5.0 AV<br>(158 + 0.17 av)  |
| Chest Manual Defrost .....                                    | 170 + 11.8 AV<br>(170 + 0.42 av) | 142 + 9.9 AV<br>(142 + 0.35 av)  | 117 + 8.1 AV<br>(117 + 0.29 av)  | 111 + 7.7 AV<br>(111 + 0.27 av)  | 102 + 7.1 AV<br>(102 + 0.25 av)  |
| Compacts:                                                     |                                  |                                  |                                  |                                  |                                  |
| Manual Defrost Refrigerator-Freezer .....                     | 292 + 13.8 AV<br>(292 + 0.48 av) | 286 + 13.5 AV<br>(286 + 0.48 av) | 280 + 13.2 AV<br>(280 + 0.47 av) | 274 + 13.0 AV<br>(274 + 0.46 av) | 274 + 13.0 AV<br>(274 + 0.46 av) |

AV = Total adjusted volume, expressed in ft<sup>3</sup>  
(av = Total adjusted volume, expressed in Liters)