

production method. Entech worked closely with 3M to develop Lensfilm™ versions of their lens. This proved to be an excellent combination, and early lenses exhibited transmissions of over 90% with reasonable manufacturing cost. Early versions of the Entech module had an efficiency of over 15% at standard test conditions (STC) [16], and this continued to improve throughout the program. Entech built four significant demonstration projects, as described below.

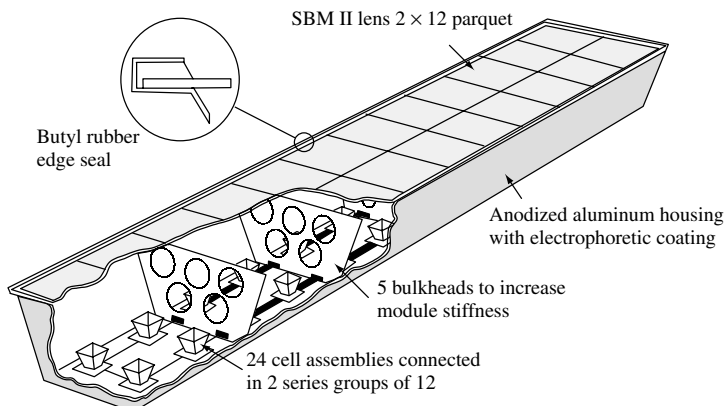
### 11.3.4 Other Sandia Projects

Throughout the 1980s, Sandia maintained a research program that included both in-house research and research sponsored at companies and universities. In-house activities included solar cell modeling and device research, module development, lens design and testing, cell packaging, and system testing and evaluation. Along with the large programs at Intersol and Entech, sponsored research included cell development at ASEC, Boeing, Varian, and university research at Purdue, Stanford, and the UNSW in Australia. This work was generally reviewed in periodic presentations at the IEEE Photovoltaic Specialists Conference. An illustrative discussion of this work toward the end of the program can be found in the 1988 review by Boes [18]. Rather than detail this work here, it will be covered in the relevant sections below.

Sandia developed a laboratory test module that demonstrated 20% conversion efficiency (STC), which pointed the way to eventual 20% commercial modules [19]. The Sandia module development culminated the Sandia Baseline III module [20]. This was intended as a concept design to be adopted and modified as needed by interested companies. Efficiency at STC was around 16 to 17%, placing it among the highest demonstrated performance for a manufacturable design at that time. Figure 11.9 shows the concept. Most commercial attempts at high-concentration modules have great similarities to this design.

### 11.3.5 The Concentrator Initiative

Despite over 15 years of sponsored research, no viable concentrator industry had emerged by 1990. Therefore, the DOE decided to create the Concentrator Initiative. This was



**Figure 11.9** The Sandia Baseline III point-focus Fresnel module design. Reproduced with permission by Sandia National Laboratories