

The application has been primarily designed to be operatorless in its execution. However, a manual override capability has been provided. No changes in existing application programs or JCL is required.

JOB PROCESSING FUNCTION

Job processing for batch jobs can be broken down into several tasks:

1. SCHEDULING. This consists of determining when to run each job that is on the Master Job list. The Master Job list is the set of all batch jobs whose processing needs to be scheduled (reasons for scheduling will be discussed). Along with the scheduling of jobs, interdependencies among jobs must be taken into consideration. Certain jobs' processing will be "dependent" upon the successful completion of other jobs. If the job stream that processes Labor vouchers aborts, we would not want to begin the processing of our Labor Variance job stream until we successfully finish the Labor Vouchers. Scheduling also includes identifying jobs that require "extra considerations" such as tape mounts or private volume mounts.

2. PROCESSING. This includes 2 interrelated tasks:

a. Streaming the jobs on the schedule. For the next job to be processed, a check must be made for the successful completion of all jobs this job is dependent on, check to make sure all extra considerations have been taken care of (private volumes, tapes, etc.), and then stream the job.

b. Monitoring the processing of each job. Processing must be monitored so that when a job finishes or aborts,

processing continues with either a restart of the aborted job or the streaming of the next available job.

3. REPORTING. After all processing is completed, the results must be recorded onto the master schedule and reported to the system users. In Data Processing it is necessary to inform the users as to what was accomplished and to inform the systems group of what problems must be fixed.

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802 2803 2804 2805 2806 2807 2808 2809 2810 2811 2812 2813 2814 2815 2816 2817 2818

Taking the job processing function described above it will now be shown how ACE is set up and executed to process jobs. Figure 2.1 shows an overview of the implementation of the ACE subsystem.



ACE: THE MASTER JOB LIST

ACE begins with the creation of a MASTER JOB LIST. This list contains all the jobs (on all the machines) that ACE will control. To create the list only two pieces of information are necessary, (1) the fully-qualified name of the file in which the JCL resides, which will be called the "JOB-NAME", and (2) the computer on which the JCL usually resides. Optional information includes "DEPENDENCIES", "EXTRA-CONSIDERATIONS", START- TIME-STOP-TIME WINDOW, DEFAULT-QUEUE, AND DEFAULT- SEQUENCE NUMBER.

Dependencies are the job-names of those jobs upon whose successful completion the current job depends. Extra considerations are dependencies that ACE can't handle. The application can check to see if the proper private volume is currently mounted, but it cannot physically mount the private volume itself. So the extra consideration is the reminder to the person setting up the daily schedule that "PRIVATE VOLUME AUDIT01 IS NEEDED FOR THIS JOB". Extra considerations are also commonly used to remind of needed tape mounts. The start-time-stop-time window allows a scheduled job to be run only between two specified times, i.e. the "window". If the window cannot be satisfied, the job is not streamed. The default queue and default sequence number allow a one-time specification of these items when their values are fairly static.

ACE: CREATING MONTHLY JOB SCHEDULES

Once the Master Job List has been specified the monthly job schedules can be created. To aid in the scheduling of jobs a set of "scheduling parameters" are defined within the system and can be used to create a schedule.

In our Accounting department we process Labor Vouchers every Wednesday night. We process our first General Ledger to microfiche on the 3rd working-day of every month. We process some jobs every other week on Monday, some jobs every day of the week and some jobs only twice a year. What we have found is that most of our jobs have a distinct pattern to their schedule. We've defined a set of parameters that describe these patterns to aid us in our monthly scheduling. These parameters allow for scheduling a job to be executed by the day of the week, the workday of the month or the particular month of the year. Using combinations of parameters any pattern can be described. There are also parameters that allow for the exclusion of days, weeks, or months.

Once the parameters have been specified for each job, creating a specified month's schedule consists of "applying" these parameters to the month's calendar. The result is the actual schedule of the date each job will run during that month. ACE maintains a table of holidays (inputted by the user) and will not schedule jobs on those specific dates. Once satisfied with the schedule for the month, and when appropriate (e.g. the beginning of the month), the schedule is activated for use.

ACE: DAILY JOB PROCESSING

Daily processing begins by entering SCHEDULER and requesting the day's schedule. All jobs scheduled for this day, and all jobs from previous schedules that either aborted or were "deferred" will be presented. Only when a job finishes successfully or is cancelled is it removed from the current schedule. Sequence numbers and queue numbers must be assigned to each job on the schedule. Dependencies are reviewed and are "deactivated" or additional added if desired. For jobs requiring private volumes or tapes, the private volume name or the logical device number on which the tape resides can be entered into the system. (PROCESSOR will then check to make sure the private volume is mounted before streaming a job and in the case of tapes will reply to the first tape request). Each job that appears on the schedule can either (1) be left scheduled to run this day, (2) deferred for future processing, or (3) cancelled from the schedule. Deferred jobs will continue to appear each following day until scheduled or cancelled. Cancelled jobs will not appear again until the next date they are scheduled to run. Jobs that were not scheduled may be added to the schedule at this time as long as they exist on the Master Job List. For all jobs that are left on the schedule, MPE passwords are entered and the schedule is ready to process.

The program PROCESSOR (Figure 3.1) executes the schedule. PROCESSOR is an online program that can be run from any terminal on the system. The program is executed in one of two modes:

- (1) AUTOMATIC RESUME mode in which PROCESSOR will execute the entire schedule without need of any user interaction. This is the pure "operatorless" mode.
- (2) MANUAL RESUME mode in which PROCESSOR will execute the entire schedule by stopping after each job is streamed and waiting for the user to let it stream its next job. This mode is extremely useful when many jobs are dependent on a single job. One can let the first job run and then monitor the job to completion before letting PROCESSOR pick the next job. Should the key job abort the user could fix the problem and restart the job so it finishes successfully. This way the jobs depending on its completion would be streamed instead of being deferred because their dependencies couldn't be met.

The program allows the user to switch between automatic resume and manual resume at any time by using control-Y. The user could monitor that first key job using manual resume and upon its successful completion leave PROCESSOR in automatic-resume and go home.

PROCESSOR picks the next job to stream according to a straightforward set of rules.

- (1) Only one job from a particular queue can be in processing at any time. Until the outcome of the current job is resolved, all following jobs in that queue wait.
- (2) Each queue is processed in the order of the sequence numbers assigned to each job. No job will be considered

(3) PROCESSOR will continually loop sequentially through the queues checking to see if the next job in each queue is ready to stream or must be deferred because of dependency aborts. PROCESSOR can have as many jobs processing as there are queues active for the schedule (it can't be more because of rule (1) and it could be less because dependencies can cross queues forcing one queue to wait until another's job finishes).

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*****
* MAIN MENU *
*****

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*****  
      *          *
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*****		*****	*****
RUN SCHEDULE	*LIST SCHEDULE*	*CHANGE SCHEDULE*	*RUN SYS UTIL*
*****	*****	*****	*****
*AUTOMATIC	*LIST SCHEDULE	*SUSPEND A QUEUE	*STREAM A JOB
RESUME	ONLINE/OFFLINE	*DELETE A QUEUE	*RUN TOP
*MANUAL	*LIST A QUEUE	*ADD, DELETE, OR	*RUN SPOOK
RESUME	ONLINE/OFFLINE	MODIFY A JOB	*EXECUTE AN MPE COMMAND
	*LIST A JOB		
	ONLINE/OFFLINE		
	*'SHOW' COMMANDS		
	SHOWJOB JOB=@J		
	SHOWJOB		
	SHOWOUT JOB=@		
	SHOWOUT JOB=@J		
	SHOWOUT JOB=@:READY,N		

Besides being able to specify which mode to run the schedule in, there are other tasks which can be performed from PROCESSOR.

Second, the schedule can be altered from within PROCESSOR. Queues can be deferred, cancelled, or suspended. Jobs can be added, modified or deleted. When modifying jobs, dependencies can be added or deactivated.

Third, PROCESSOR uses process handling to allow the user to stream a job, run TDP.PUB.SYS, run SPOOK.PUB.SYS, or execute other APE commands. This is to allow for restarting aborted jobs from within PROCESSOR. SPOOK is used to read spoolfiles, TDP is an editor, and the stream command not only streams the job but also sets up the job streamed as an ACE job.

QUEUE	PRIORITY*	STATUS	COMPUTER	CODE	JOB-NAME	DEPENDENCIES/ EXTRA CONSIDERATIONS
01*10*01	R				JOB11.GROUP.ACCOUNT	**JOBXX.GROUP.ACCOUNT **JOBY.Y.GROUP.ACCOUNT JOBZZ.GROUP.ACCOUNT
01*20*02	S				JOB12.GROUP.ACCOUNT	**JOB11.GROUP.ACCOUNT NEEDS TAPE MOUNT FOR LAST STEP

Figure 3.2 Current Schedule List

JOB11.GROUP.ACCOUNT

STATUS-CODE: SCHEDULE-DAY:

QUEUE-NUMBER: __ DEFAULT-QUEUE-NUMBER: __

PRIORITY: __ DEFAULT-PRIORITY: __

COMPUTER-NUMBER: __ DEFAULT-COMPUTER-NUMBER: __

START-TIME: _____ START-TIME-WINDOW: _____

STOP-TIME: _____ STOP-TIME-WINDOW: _____

AVG-RUN-TIME: _____

1 2 3

12345678901234567890123456789012

THIS MONTH'S SCHEDULE: 0000R0AR0000DR010000010000010001

DEPENDENCIES: JOBXX.GROUP.ACCOUNT
 JOBY.Y.GROUP.ACCOUNT
 JOBZZ.GROUP.ACCOUNT

EXTRA CONSIDERATIONS:

JOB11.GROUP.ACCOUNT INFORMATION:

Figure 3.3 Current Schedule Job Information.

When PROCESSOR finishes processing the production schedule the last job streamed generates a report summarizing the results of the processing. Aborted jobs, deferred jobs, cancelled jobs, and successful jobs are all reported in this report. We then post this report for the users.