SPARING STRATEGY FOR MINICOMPUTERS
MINICOMPUTER MAINTENANCE AND OPERATIONS CENTER
COMPUTER SYSTEM MEASUREMENT
INFORMATION SYSTEMS

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1. GENERAL

1.01 This section explains the factors involved in spare parts provisioning for minicomputers maintained by the Minicomputer Maintenance Group (MMG) of the Minicomputer Maintenance and Operation Center (MMOC). This section renumbers Section 190-020-569.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 The title for each figure includes a number in parentheses which identifies the paragraph in which the figure is referenced.

1.04 The use of General Trade Products (GTP) Vendors' terms or procedures does not imply endorsement or exclusion of other products. For brevity and simplicity, the only products covered are those presently having a significant factor in OSS design and support. Other products may be included at a later date.

2. SPARING STRATEGY

2.01 ***Vendor Recommendations:*** The vendor's recommendations should be carefully examined and weighted in accordance with the considerations contained in this section. The vendor's recommendations should give the number of spares needed for the existing service population at a desired level of service (LOS) expressed as a percent. A 90 percent LOS is recommended for establishing an initial parts inventory. See Fig. 1 for a description of Digital Equipment Company's (DEC) LOS procedure and Fig. 2 for an example of a recommended spares list (RSL).

2.02 A complete equipment inventory of all systems must be provided to the vendor for spares recommendations. This inventory data can be obtained from the minicomputer system inventory printout which is defined in Section 190-020-531 or from a physical inventory of installed equipment.

2.03 The DEC LOS is a criterion for selecting which parts of a given major equipment unit (option) should be stocked. This selection or parts mix is independent of the total number of options and does not determine the quantity of each of the stocked parts. The number associated with the LOS is the percentage of failures for which a spare part is stocked (but not necessarily available). The spare parts are selected on a cost effective basis which gives stocking preference to

high-usage low cost parts, and are calculated for each option within the self-maintenance configuration.

2.04 Figure 1 shows an example of how DEC selects the parts mix used in their quotes. The first column is the part or module number. The second column is a usage figure for that part for 100 options for six months. The third column is the cost of a single part. The fourth column is the index which is computed by squaring the usage and dividing by the cost. The parts in the table have been ranked according to this index. This ranking attempts to show some cost effective way of selecting which parts should be stocked. The next column is the incremental LOS.

2.05 The incremental LOS of a part is the usage of that part divided by the total usage of all the parts. The incremental LOS is the percentage of failures which are caused by each part. The last column of Fig. 1 is the cumulative LOS which is the sum of the incremental LOSs up to that line. DEC would normally round up the numbers in the last column to the next multiple of 10 so that both 81.81 and 83.63 would be given at 90. The parts mix for a 90 percent LOS quote would then include all parts which were at or below a cumulative LOS of 90.

2.06 ***Failure Rates:*** A vendor spare parts quotation is based upon parts cost and estimated failure rates. Internal (Operating Telephone Company [OTC]) tracking of the actual failure rates encountered should be used to modify the vendors data. Consideration should be given to reducing quantities of low usage items, and the purchase of additional spare parts where usage dictates.

2.07 ***Number of Stocking Locations:*** The number of part's locations will generally be determined by the number and geographic distribution of the systems being maintained. The quantity of clustered/nonclustered sites can affect the quantity of spare parts required in the MMC inventory. In general, significant advantages can be gained by minimizing the number of stocking locations.

2.08 ***Spare Parts Kits:*** A maintenance kit is a group of spares applicable to one major item of hardware (eg, DEC PDP 11/40*, 11/70, RP06, etc). There should be a sufficient number of kits to meet the service needs of the geographically distributed systems. Critical systems may have local kits at the site of the Operations Support System (OSS).

*Registered trademark of the Digital Equipment Corporation.

2.09 The use of maintenance kits can increase the overall parts inventory because kits are designed to support a major equipment item, and duplication of parts can exist. An example would be the M7800 TTY interface. One spare module of this type may support all on line PD 11/40 and 11/45 hardware, but two may have to be purchased if separate kits are established for each type of PDP hardware. Revisions to DEC recommended spares list (RSL) procedures eliminate overstocking because of kit arrangements. However, local maintenance requirements may demand establishing option kits that will increase parts investment. (Refer to Information Letter [IL] 79-04-213.)

2.10 Board swapping to isolate a trouble condition is another factor which may increase the quantity of maintenance spare parts required. It is recommended that parts consumption be tracked carefully, to ensure that proper diagnostic techniques are being applied, for trouble isolation, rather than trial and error parts change out. Several vendors are using parts consumption data as part of their evaluation of maintenance organization and personnel performance.

2.11 ***Module Repair:*** The repair of module circuit boards can be provided by the vendor or by OTC technicians. In-house repair will decrease the turnaround time and reduce the number of spares but will increase the cost of tools and test equipment and require an additional inventory of circuit components. Generally, in-house module repair is considered economically advisable, and is recommended.

2.12 Components that are supplied to rather than manufactured by the vendor historically require a lead time of 3 months or more. Careful tracking of consumption versus supply will be necessary for these items. Identification of long lead time components should be included as a part of the negotiations with the vendor when establishing the initial spares inventory.

2.13 ***Turnaround Time:*** The turnaround time is the time that it takes to return a defective part to useful service. This time could be as short as several hours if the OTC is doing

module repair. However, the time could be as long as the vendor's lead time, in addition to shipping interval, if the module is not repairable. In the case where the vendor repairs the modules, there may be a minimum time to repair or replace the module.

2.14 The assumed repair/replacement time (turnaround) should be clearly identified in the vendor parts recommendation. Any part that appears to have excessive replacement time (greater than 8 weeks) should be discussed with the vendor to ensure availability. Parts negotiation with the vendor should also address the issues of spare parts kits, module repair and emergency procurements.

> ***Note:*** The recommended quantity of spare parts contained in the DEC RSL are computed on an assumed 8 week availability. It is essential that parts not meeting this availability be identified, and inventories adjusted accordingly.

3. SPARE SYSTEMS AND OPTIONS

3.01 ***Duplex System:*** A duplex system is the secondary system providing on-line processor redundancy. It monitors the primary system, shares its data base and is ready to assume the working role when a failure is detected, eg, Hotel Billing Information System (HOBIS). It generally cannot be used for testing new and repaired modules due to its close coupling with a working system. It should not be cannibalized and its components should be inventoried as working parts, ie, Form E-6634D, and not as spare parts.

3.02 ***Hot Spare System:*** A hot spare system is a complete system that can be switched into service in place of a system that is down. It requires the switching of communication lines and loading of the data base. It can be used for testing new and repaired modules but not for cannibalization. The components of a hot spare system should also be inventoried as working parts and not as spare parts.

3.03 ***Test System:*** A test system consists of a processor and one each of the highly used peripherals maintained by the MMG. It resides in the MMG and can be used for testing new and required modules. It can be used to augment the spares inventory and may be used to replace whole options such as a complete disk, tape drive, etc. These systems enhance OTC board repair and testing newly purchased spare parts. Procurement of a test system may be more economical through the OTC engineering group, when a system is being replaced (ie, material only or junk value). These systems should be inventoried as working rather than spare parts.

3.04 ***Spare Options:*** An option is generally defined as a major equipment component (eg, PDP 11/70, RP06). Spare options are processors or peripherals that are purchased for use as spare parts. They are useful in providing one of every spare part at a cost less than the sum of those parts purchased individually. They can be cannibalized or used as a complete replacement for defective equipment and are most useful in clustered sites where there are many common options.

3.05 ***Manufacturers Availability:*** The source of parts should be closely scrutinized, ie, do the manufacturers keep the part in stock or is there a lead time because it is supplied by the OEM? Availability should be a major consideration when establishing a vendor agreement.

3.06 ***Vendor Services:*** Spare parts services are available from some vendors. An additional charge for 24-hour service is normally incurred. Figure 3 tabulates the advertised offerings of the major OSS minicomputer vendors, regarding purchase, repair or replacement of parts (should be verified with the vendors). Local sales personnel should be contacted for information and instruction on subscribing to these offerings.

> ***Note:*** The DEC module mailer service does not cover all modules, ie, other modules must be repaired/replaced via their repair and return service.

3.07 ***Inventory Requirements:*** An inventory of spare parts is essential to the operation of an MMG. Manual inventory methods can be used but as maintenance effort grows, they become cumbersome and are usually too slow to feedback useful information. A computerized data base may be needed that serves both the present and future needs of the MMC. The data base is an inventory of all parts and should consist of the following items.

(a) Status (in use, spare, in repair, loaned or scrapped)

(b) Location (OSS, test system or spares depot)

(c) History (revision level, FCO status, repair frequency)

(d) Accounting (purchase date, cost, accounting code, date scrapped).

3.08 The list in paragraph 3.07 is not exhaustive but contains sufficient information to keep track of both the parts and the systems in which they reside. Programs that would query such a data base could compute the present and future needs of stocking, locate troubles associated with any particular module or option, check stocking levels and establish replenishment intervals.

3.09 The output reports that could be available from a mechanized inventory system would typically be in the following categories.

(a) Part Listings

(b) Threshold Report (Reorder)

(c) Purchase Order Report

(d) Part Usage Report

(e) Parts on Loan Report

(f) FCO Status Report

AT&T and BTL are evaluating several OTC developed inventory programs for Bell System application.

3.10 ***Alternate Suppliers:*** Consideration should be given to the purchasing of some parts and components directly from the manufacturer (OEM) or an alternate supplier. In particular, a reliable local distributor of electrical components should be identified as an emergency source. Care should be taken in the selection of alternate suppliers. Purchased components must meet the OEM design specifications and must not void service or performance warranties.

3.11 Many OEMs will not sell parts directly to an OTC because of the supplier contract they have with computer vendors. In these instances, a separate purchase agreement can normally be negotiated between the OTC and the OEM by contacting their parts department manager.

3.12 ***Emergency Planning for Stock Outage:*** The MMC should have a plan for emergency conditions during stock outages. The plan will necessitate some working relationship with other OTCs which may take the form of lending both parts and expertise. Consideration should also be given to executing a "service support agreement" with a vendor. This agreement should provide for access to local field stock.

3.13 ***Advance Notification of New Systems:*** The time frame of all future OSSs, that will be self maintained, should be made available to provide the lead time necessary (from 6 to 12 months) for ordering additional spare parts. The MSG would normally have access to this information and should be consulted to provide the OSS service date, site, and model of hardware/peripherals.

4. CIRCUIT PACK HANDLING AND STORAGE

4.01 ***General Precautions:*** Semiconductor devices and their associated circuit packs or cards are physically constructed to withstand limited mechanical shock resulting from dropping or jolts of a normal manner. Mechanical damage of the circuit pack may result from the following:

(a) Dropping on bench or floor

(b) Stacking packs on or against one another

(c) Applying direct pressure to components

(d) Failure to protect connector contacts (Touching connector contacts contaminate gold plating and causes poor connections.)

(e) Exposing IC chips to high potentials/static electricity.

4.02 ***Unpacking:*** When unpacking new circuit packs, inspect for mechanical damage, warpage and card oversize. Any dirt or discoloration on the gold plated connector contacts should be removed. ***Wipe the connector edge with a KS-2423 lint-free, twill-jean cloth.***

> ***Warning: The use of the proper cleaning solvents will avoid the harmful effects and often delayed damage to electrolyte capacities, IC chips and gold contacts. Section 032-173-301 recommends KS-19416, L2 as a lubricant***

and KS-7860 trichloroethane petroleum spirits as a cleaning advent.

4.03 ***Storage:*** When possible, circuit packs should be stored in protective cartons to protect against dirt, dust, or damage.

4.04 Circuit packs should not be dumped into cartons and bins since mechanical shock may shorten their life expectancy. If protective cartons are not available, each device or circuit pack should be isolated to prevent the possibility of mechanical shock. Circuit packs should be stored in a manner which readily exposes the code on the pack or marking on the container.

4.05 ***Transporting:*** When transporting circuit packs, it is essential that they be placed in a container that will provide maximum protection against physical shock or any harmful environment. When shipping circuit packs for repair, extreme care must be taken to prevent damage during shipment. If at all possible, the circuit pack should be returned in the containers in which they were received.

RXX90 TAPE DRIVE

MODULE	6 MONTH USAGE	COST	INDEX	INCREMENTAL LOS	TOTAL LOS
M66X	9	8.55	9.474	16.36	16.36
M67X	10	28.01	3.570	18.18	34.54
M68X	4	5.10	3.137	7.27	41.81
M69X	5	11.70	2.137	9.09	50.90
M70X	4	13.59	1.177	7.27	58.18
M71X	4	17.00	.941	7.27	65.45
M72X	2	5.09	.786	3.63	69.09
M73X	3	13.32	.676	5.45	74.54
M74X	2	6.35	.630	3.63	78.18
M75X	2	7.23	.553	3.63	81.81
M76X	1	4.37	.229	1.81	83.63
M77X	6	218.75	.165	10.90	94.54
M78X	1	6.74	.148	1.81	96.36
M79X	1	10.76	.093	1.81	98.18
M80X	1	18.71	.053	1.81	100.00

Fig. 1—DEC Level of Service Procedure (2.01, 2.04, 2.05)

DATE : 10-12-78 CUSTOMER : QUOTE # : 28580l TYPE : 9
COUNTRY : UNITED STATES CURRENCY : DOLLARS
SORTED BY : CONFIGURATION

ITEM NUMBER	QTY	DEC PART NUMBER	DESCRIPTION	UNIT PRICE	EXTD PRICE	OPTION	LEAD TIME
523	7	29-21266-00	29PCHA DISC SPEED SENSOR	410.00	2870.00	RP04-AA	A
524	1	29-21268-00	29FAILSAFE RES ASSY	418.00	418.00	RP04-AA	A
525	2	29-21269-00	29MOTOR ASSY, BRUSH DRIVE	61.00	122.00	RP04-AA	A
526	7	29-21270-00	29POWER DRIVE ASSY	1110.00	7770.00	RP04-AA	A
527	4	29-21271-00	29FAN	171.00	684.00	RP04-AA	A
528	2	29-21272-00	29BLOWER ASSYBBHZ	315.00	630.00	RP04-AA	06
529	7	29-21277-00	29HEAD ASSY AV	256.00	1792.00	RP04-AA	A
530	7	29-21278-00	29HEAD ASSY AD	256.00	1792.00	RP04-AA	A
531	7	29-21279-00	29HEAD ASSY BU	256.00	1792.00	RP04-AA	A
532	7	29-21280-00	29HEAD ASSY BD	256.00	1792.00	RP04-AA	A
533	3	29-21281-00	29HEAD ASSY, SERVO	317.00	951.00	RP04-AA	A
534	2	29-21373-00	29BRKT SHIP LOCK	8.00	18.00	RP04-AA	A
535	2	29-21374-00	29COVER EMA	60.00	120.00	RP04-AA	A
536	3	29-21377-00	29SOLENOID	18.00	54.00	RP04-AA	A
537	2	29-21378-00	29SENSOR ASSY SPD	67.00	134.00	RP04-AA	A
538	3	29-21379-00	29SWITCH ASSY PACK ON	34.00	102.00	RP04-AA	A
539	2	29-21380-00	29BELT SPNDL DR60	14.00	28.00	RP04-AA	A
540	2	29-21382-00	29MOTOR ASST, DRIVE 60HZ	612.00	1224.00	RP04-AA	A
541	2	29-21384-00	29STRAP EHA ORND	7.00	14.00	RP04-AA	A
542	2	29-21387-00	29SEQUENCER AS 60	2147.00	4294.00	RP04-AA	A
543	2	29-21389-00	29COIL ASSY EHA	246.00	492.00	RP04-AA	A
544	3	29-21391-00	29SHAFT ASSY SPINDLE LOCK	2293.00	6879.00	RP04-AA	A
545	4	29-21391-00	29PULLEY ASSY HIR	155.00	620.00	RP04-AA	A
546	7	29-21395-00	29MOUNT AS BRUSH	34.00	238.00	RP04-AA	04
547	2	29-21397-00	29MOTOR ASSY, BRUCH DRIVE	79.00	158.00	RP04-AA	A
548	1	29-21404-00	29GRATIN ASSY PRIMARY	236.00	236.00	RP04-AA	A
549	3	29-21406-00	29GRATIN ASSY SECONDARY	105.00	315.00	RP04-AA	A
550	7	29-21407-00	29CAM	34.00	238.00	RP04-AA	A
551	2	29-21410-00	29SHAFT AS LWRLCK	63.00	126.00	RP04-AA	A
552	2	29-21411-00	29SHAFT AS UPRLCK	80.00	160.00	RP04-AA	A
553	2	29-21419-00	29CIRCUIT BREAKER	26.00	52.00	RP04-AA	A
554	3	29-21424-00	29SWITCH MDM SPOT	22.00	66.00	RP04-AA	04
555	1	29-21489-00	14SWITCH ASSY 4 POS SPOT	41.00	41.00	LP05	A
556	2	29-21472-00	14TRACTOR LEFT	137.00	274.00	LP05	A
557	2	29-21473-00	14TRACTOR RIGHT	137.00	274.00	LP05	A
558	1	29-21475-00	14PCBA SENSOR HB	42.00	42.00	LP05	A
559	1	29-21476-00	14PCBA EMITTER HB	24.00	24.00	LP05	03
560	1	29-21477-00	14PCBA SENSOR PD	60.00	60.00	LP05	A
561	1	29-21478-00	14PCBA EMITTER PD	58.00	58.00	LP05	04
562	1	29-21633-00	14PULLEY, DRUM MOTOR	27.00	27.00	LP01	06

Fig. 2—Recommended Spares List (2.01)

COMPARATIVE PURCHASE

VENDOR	RESPONSE	SERVICE	COST
Digital Equipment Corporation	7 Working Days	Module mailer	Prepayment with up to 12 percent discount.
Digital Equipment Corporation	24 Hours	Hotline	$50 per order in addition to cost of part and transportation.
Digital Equipment Corporation	20 Working Days	Repair and return	Fixed fee, depending on part.
Hewlett-Packard	24 Hours	Hotline	$50 per order.

Fig. 3—Illustrations of Comparative Purchase and Replacement Costs (3.06)