
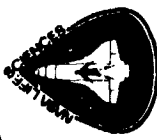



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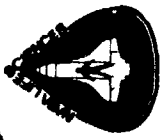
 <p>Kennedy Space Center</p>	<p>SPACE STATION HUMAN PRODUCTIVITY WORKING GROUP CONTAMINATION</p>	<p>BIOMEDICAL OFFICE FEBRUARY 28, 1984</p>
<p>DEFINITION: <u>CONTAMINANT</u> → <u>CONTAMINATE</u></p> <p>REFERS TO THAT WHICH ON COMING INTO CONTACT WITH SOMETHING WILL MAKE IT IMPURE, UNCLEAN, OR <u>UNEFIT FOR USE</u>; TO POLLUTE, SOIL, DECAY, INFECT, OR CORRUPT; TO <u>COMPROMISE</u> OR ADVERSELY AFFECT <u>BEING AND FUNCTION</u> WITH UNDESIRABLE ELEMENTS.</p> <p>THIS IMPLIES THAT AN ORIGINAL CONDITION PRECEDES CONTAMINATION -- APPLICABLE TO INTENDED SPACE STATION DESIGN.</p> <p>BASIC COMPONENTS IN CONTAMINATION:</p> <p>A. <u>THAT WHICH IS CONTAMINATED</u></p> <ul style="list-style-type: none"> ● HUMAN CREW - PREEMINENTLY ● OTHER LIFE FORMS ● EQUIPMENT AND SYSTEMS ONBOARD ● PROCESSES AND ACTIVITIES <p>N.B.: AS IN THE HUMAN CASE, MANY ELEMENTS CAN BE EITHER OBJECT OR SOURCE OF CONTAMINATION!</p> <p>B. <u>CONTAMINANTS (FACTORS)</u></p> <ul style="list-style-type: none"> ● TYPES AND SOURCES ● EFFECTS AND CONSEQUENCES ● ASSESSMENT AND QUANTIFICATION ● CONTROL AND DECONTAMINATION 		

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<p style="text-align: center;"><u>THE PROBLEM</u></p> <p>THE "NEW WORLD" REVISITED</p> <ul style="list-style-type: none"> ● GROWING POPULATION IN ORIGINALLY PRISTINE ENVIRONMENT ● LIMITED BASIC RESOURCES ● INCREASING AMOUNTS OF WASTE/DEBRIS INTO A FINITE CONTAINMENT ● BYPRODUCTS AND EFFLUENTS OF INDUSTRIALIZATION ● MICROBIAL THEORY REASONABLY WELL UNDERSTOOD AND OPERATIVE ● EXOTIC AND UNEXPECTED INPUTS (E.G. NUCLEAR WASTES, BIZARRE REACTIONS) ● INCOMPATIBILITIES OF VARIED INTEREST GROUPS ● MENTAL AND PSYCHIC OVERLOAD <p>N.B.: PROGRESS OF THESE CONTAMINATING EVENTS IN A MICROCOSM WILL FOLLOW A GREATLY COMPRESSED TIME SCALE WITH LIMITED BUFFER CAPACITY</p>		

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PURPOSE - TASKS

- RECOGNIZE AND EVALUATE THE PROBLEM(S) - DESIGN SPACE STATION ACCORDINGLY
- IDENTIFY POTENTIAL CONTAMINANTS - SOURCES AND TYPES
- DETERMINE SCOPE AND MAGNITUDE OF CONTAMINATION EFFECTS: TOXICOLOGICAL, MICROBIOLOGICAL, IMPURITIES
- DEVELOP MATHEMATICAL MODELS FOR PREDICTIVE METHODS
- IDENTIFY STATE-OF-THE-ART AND ADVANCED TECHNOLOGIES NEEDED FOR MONITORING CONTAMINANTS AND FOR DECONTAMINATION
- DESIGN AUTOMATED MONITORING AND CONTROL SYSTEMS - LINKED TO TOX DATABASE AND MATH MODELS
- DETERMINE OPTIMAL MEANS FOR MANAGING CONTAMINATION AND DESIGN AS INDICATED - A GLOBAL ISSUE
- ESTABLISH ESSENTIAL BACK-UP PROVISIONS AS AUXILIARY MEDICAL DATABASE TO ASSIST RAPID DELIVERY OF APPROPRIATE MEDICAL CARE

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SOURCES AND TYPES OF CONTAMINANTS:

- FUELS AND MECHANICAL SYSTEMS
- PAYLOADS/EXPERIMENTS
- HUMAN CREWMEMBERS
- NON-HUMAN BIOLOGICALS
- MATERIALS
- ENERGIES
- CHEMICALS
- GASES
- PARTICULATES
- AEROSOLS
- MICROBIOLOGICALS
- ELECTROMAGNETIC RADIATION
- IONIZING RADIATION
- THERMAL ENERGY
- MECHANICAL ENERGY

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HUMAN TOXICOLOGIC DATA BASE


- MAJORITY OF CONCERNS FOR HUMAN CREWS
- UNIQUE SPACE STATION CONDITIONS
 - CONTINUOUS 24-HOUR EXPOSURE (8-HOUR TLV'S NOT APPLICABLE)
 - SYSTEM NOT PERIODICALLY REFURBISHED (PURGED, GROUND PROCESSED)
 - HAZARDOUS OPERATIONS/MATERIALS NOT PREVIOUSLY ENCOUNTERED
- LIKELIEST PROBLEMS, ORGAN SYSTEMS AFFECTED, CONSEQUENCES
- INTERRELATION WITH MEDICAL CARE SYSTEM


MICROBIOLOGICAL POTENTIAL PATHOGENS

SYSTEMS MALFUNCTION

- LIFE SUPPORT SYSTEM (ANOMALOUS, OVERLOAD)
- OPTICAL SURFACES, ELECTRONICS
- MATERIALS PROCESSING
- HOUSEKEEPING

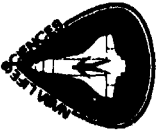


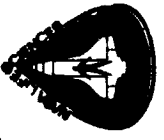
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<p><u>QUANTIFICATION OF CONTAMINANTS</u></p> <ul style="list-style-type: none"> ● KNOWN <ul style="list-style-type: none"> ● HUMAN OUTPUTS <ul style="list-style-type: none"> - RESPIRATORY - SKIN - URINARY - GASTROINTESTINAL ● OTHER LIVING COMPONENTS ● FOOD PRODUCTS, PROCESSING BYPRODUCTS ● ONBOARD MATERIALS ● MICROBIOLOGICALS ● LESS WELL DOCUMENTED <ul style="list-style-type: none"> ● MATERIALS PROCESSING ● MICROBIOLOGICALS - MUTANTS, VARIANTS ● EXOTIC PHYSICO-CHEMICAL REACTIONS ● ONBOARD INCIDENTS (I.E., SPILL, FIRE) ● PREDICTIVE MODELLING <ul style="list-style-type: none"> ● REQUIRES CONTINUOUSLY UPDATED DATABASE 		


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SOLUTIONS:

- PREVENTION
- MONITORING
 - TECHNOLOGIES, SENSORS, ANALYZERS; DISTRIBUTION, FREQUENCY
 - DATA INTERPRETATION, DECISION
 - RESPONSE ACTUATORS
- ACTION/CONTROL
 - ALARMS
 - REDUCTION, ELIMINATION
 - DECREASE INPUT, INCREASE FILTRATION/SCRUBBING, PURGE
 - ISOLATION, SHIELDING, PROTECTIVE DEVICES
 - RETREAT (SAFE HAVEN)
 - MEDICAL TREATMENT (OR SYSTEMS' EQUIVALENT)
- AUTOMATION
 - MINIMIZE HUMAN REQUIREMENTS FOR CONTAMINATION CONTROL, DECONTAMINATION

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<p><u>HISTORICAL LESSONS</u></p> <ul style="list-style-type: none"> ● ALL SPACE CRAFT EXPERIENCE TO DATE <ul style="list-style-type: none"> - EMPHASIS ON LONGER DURATION - ATTENTION TO MORE SERIOUS/POTENTIAL PROBLEMS (E.G., HYPERGOLS, WASTE MANAGEMENT) ● SUBMARINES ● MINING ● METALLURGICAL INDUSTRIES ● CLEAN ROOMS ● MEDICAL ISOLATION ● MICROBIOLOGICAL RESEARCH AND MANUFACTURING ● EXTREME ENVIRONMENTS (E.G., BAROMETRIC PRESSURE, TEMPERATURE, HUMIDITY) 		

 <p>Kennedy Space Center</p>	<p>HUMAN PRODUCTIVITY WORKING GROUP SPACE STATION CONTAMINATION</p>	<p>BIOMEDICAL OFFICE FEBRUARY 28, 1984</p>
<p><u>TECHNOLOGIES REQUIRED:</u></p> <p>INTEGRAL TO ALL OF SPACE STATION; COMPELLING FOR ECLSS AND LOGISTICS MODULE</p> <ul style="list-style-type: none"> ● DETERMINE BEST MEANS (OR OPTIONS) FOR HANDLING EACH CASE ● IDENTIFY STATE-OF-THE-ART AND NEW TECHNOLOGIES TO IMPLEMENT ● GROUND TEST/MATH MODEL TO OPTIMIZE CONTROL ● DESIGN CONTROL AND MONITORING SYSTEMS TO MAXIMIZE AUTOMATION ● FLIGHT TEST COMPONENTS/SUBSYSTEMS WHERE FEASIBLE ● DETERMINE DEGREE OF SYSTEM CENTRALIZATION VERSUS MODULAR INDEPENDENCE ● ASSURE CAPABILITY TO UPGRADE SPACE STATION SYSTEMS <p><u>N.B.:</u> SIZE, MASS, SPACE, COST WILL NECESSARILY CONSTRAIN TECHNOLOGIES</p>		

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<p><u>MAJOR AGENCY DECISIONS FOR THE CONTAMINATION ISSUE</u></p> <ul style="list-style-type: none"> ● MISSIONS AND OBJECTIVES OF SPACE STATION ● CENTRAL VERSUS DISTRIBUTIVE/MODULAR SYSTEM ● ESTABLISHMENT OF APPLICABLE TOXIC EXPOSURE TOLERANCES ● LEVEL OF AUTOMATION VERSUS HUMAN RESPONSIBILITY ● ELEMENTS AND DEGREE OF SYSTEMS CLOSURE ● WHEN TO FREEZE TECHNOLOGIES 		