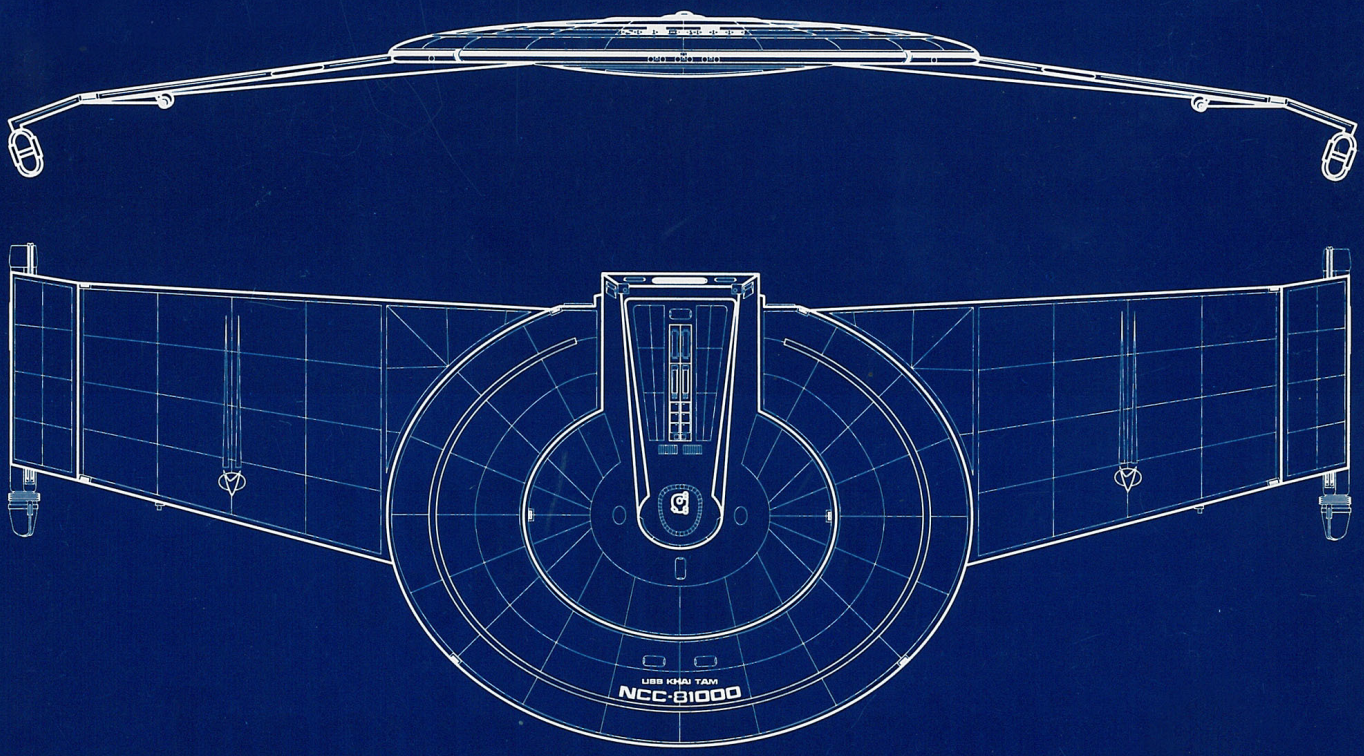
TECHNICAL SPECS ON THE GALAXY'S FIRST FEDERATION–KLINGON HYBRID STARSHIP

$12.95

USS Khai Tam Technical Orientation Manual



written & illustrated by KEVIN MCNULTY

additional writing & editing by COLIN TOENJES

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USS Khai Tam NCC-81000

Technical Orientation Manual

To the crew of the
starship *Khai Tam*.

A ship in its harbor is
safe, but that's not what
ships are for.

The USS Khai Tam Techincal Orientation Manual

written & illustrated by Kevin McNulty

additional writing and editing by Colin Toenjes

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Contents

Acknowledgments

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Jon "K'jonn" Reddick, Brien "Q" Allen, and the original crew of the **USS *Khai Tam*** for giving birth to the idea of a technical manual.

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My wife, **Debbie,** for her patience and support despite her new-found loathing for my Mac; and my son **Sean** for keeping things in perspective for me.

—Kevin McNulty

Editor's Acknowledgments

I would like to throw in some acknowledgments of my own. There are many people who have supported me in my hobby over the years.

To **Matthew D. Gandy, Maelanie Schweitzer, Philip Shannin, Michael Kelly, and Jennifer Pierce,** my "roommates", for fielding innumerable calls, and for putting up with me.

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To the following people, for all their help:

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And, especially, to **Kevin McNulty** without whose help this project would still be sitting at the bottom of my "things to do" list.

—Colin Toenjes

Introduction

Ever since my first Starfleet Technical Manual, I have been fascinated by "Treknology". The concept that there were people out there with the creativity and intelligence to actually try to rationalize the props, sets, and sometimes outlandish notions of a futuristic TV show gave me hope that I wasn't the only grown-up interested in playing a surprisingly sophisticated game of make-believe.

Since that first book there have been many others, ranging from the "official" materials blessed by studios and publishers, to the creative albeit less popular works of fan-authored derivation. As I purchased and read each one, it laid the subconscious groundwork for the book you see here.

Not that this book was my idea. Far from it, the idea of this manual was spawned by the original crew of the starship *Khai Tam* (in reality, the Tallahassee, FL chapter of Starfleet—The International Star Trek Fan Association). The hybrid Federation-Klingon starship, the saucer-wing design, the idea to write a technical manual—all originated in this zealous group of fun-loving fans. When I joined their ranks in 1993, the Tech Manual project was already underway.

When I volunteered to help, Chief Engineer Colin Toenjes was kind enough to give me the ball and let me run with it. The creativity spawned by the aforementioned works began to pour out of my head and into my trusty Mac, and thankfully the crew let it happen. If this book is ever successful, I owe them a debt of gratitude for letting me do this project. Of course if it's not, it will be all their fault for coming up with the dumb idea in the first place (*grin*).

What you will find in these pages is a collection of text and illustrations, executed in exhaustive detail, that explain the technology and operation of the first Federation-Klingon designed starship in existence. In its 16 chapters I have tried to answer questions about starship operations that I have been asking for years ("Who gets holodeck time, and when?"; "Is there a really nice restaurant aboard?"). I have also tried as much as possible not to rehash the concepts and theories already espoused by previous works.

The result, I hope, is a fresh, new, fan-generated publication that will make a fine addition to your Treknology library. Then again, it could just be a fun book to read. Either way, I hope you'll enjoy it.

—Kevin McNulty

Imagination is the beginning of creation. You imagine what you desire; you will what you imagine; and at last you create what you will.

—George Bernard Shaw

1
History and Development

To understand how the *Khai Tam* operates on a day to day basis, it is necessary to learn how this unique class of ships came to be.

The battle at Wolf 359 taught the Federation a very painful lesson. A determined and resourceful enemy with superior technology was able to decimate a large portion of the fleet with a single ship. It was clear that despite Starfleet's primary mission of exploration and research, new and more sophisticated weapons platforms were needed. The unknown was becoming a very dangerous place.

Mission Objectives

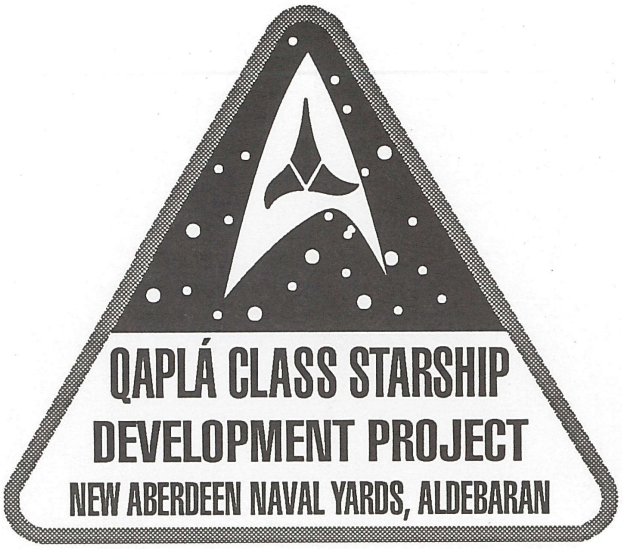
Even before the Borg threat was discovered, plans were underway for a new class of starship that would be able to meet the ever increasing threat of high-technology enemies. The old *Excelsior* class and rapidly aging *Ambassador* class heavy cruisers (HC) just weren't up to the task; the *Galaxy* class exploratory cruiser (EC) and the *Nebula* class cruiser (C) had the range and speed, but their defensive systems were limited in their adaptability.

A new weapons system was needed, and for the first time since the *Belknap* class was launched, the category of strike cruiser (SC) was back on the drawing board. Several shipyards began development work in various directions, but in the absence of a Starfleet design directive, their efforts lacked focus.

The attack on Wolf 359 crystallized Starfleet into action and increased the pace and intensity of the design effort. Specifications were issued for the new starship. Originally called the *Relentless* Class Development Project, Starfleet Defense Directive D1114.1 established the following mission parameters:

1. Provide a sophisticated weapons platform capable of rapid deployment at high warp and armed with a wide range of highly flexible weaponry that can be adapted to meet the changing face of an enemy.
2. Provide sufficient weapons and shielding capability to allow the ship to delay a Borg class vessel for five hours.
3. Provide autonomous capability for full execution of Federation policy options in outlying areas.
4. Incorporate sufficient scientific and cultural research facilities for full strategic and tactical analysis and autonomous decision-making in outlying areas.

As the *Relentless* Class Project was just beginning, the Klingon High Council was entertaining a proposal from the Federation to work on a joint-design starship as a measure of solidification of the New Alliance. On learning of the *Relentless* Class Project, the High Council



Above: The logo of the Qapla' class project. Not surprisingly, there was much debate between the two design teams before this compromise was reached. The Starfleet delta/Klingon tri-foil symbol was intentionally left open to interpretation: Starfleet die-hards see the delta as "encompassing" the trefoil while their Klingon counterparts interpret the tri-foil as being imposed "on top of" the delta.

responded that a new superior weapons platform would be a starship design worthy of Klingon engineering, and that they would participate in the joint-design project only on such a vessel.

At first hesitant, Starfleet soon recognized the advantages of Klingon input on such a ship. Almost six months after it had begun, the *Relentless* Class Project was renamed the *Qapla'* Class Development Project (*Qapla'* is Klingon for success).

While much of the work done on the *Relentless* project was shelved in favor of a "clean slate" approach, the mission objectives remained essentially the same with one important exception. A new objective was added to the list that was particularly Klingon in nature:

5. Equip the ship with the ability to approach a target or target zone by stealth.

To provide for these mission parameters, the Starfleet Design Advisory Commission (SDAC) and the Klingon Council on Warship Design (KCWD) recommended that the *Qapla'* class starship meet or exceed design goals in the following specification categories:

Propulsion

- Sustainable cruise velocity of Warp Factor 9.8. Ability to maintain speeds of up to Warp 9.95 for periods of up to ten hours.
- Federation fifth-phase dilithium controlled matter/antimatter reactor providing primary power. This recommendation was made largely due to the better crystal efficiency and flow regulation of the Federation design.
- Klingon warp drive nacelles. This recommendation was an acknowledgment of the more powerful driver coils and better lobe stability of the Klingon nacelles.
- Sustainable field output to exceed 2000 cochranes, peak transitional surge reserve to exceed 5000% of nominal output.
- Warp field geometry to incorporate modified 55° Z-axis compression characteristics on forward warp lobe for increased peak transitional efficiency.
- Klingon impulse drive system to provide flank speeds in excess of .95c.
- Bi-redundant multiport reaction control system to provide maneuverability.

Mission/Tactical

- Ability to operate independent of starbase refurbishment for extended periods. Independent patrol mode of one Standard Year at nominal Warp 6 velocity.
- Ability to execute tactical and strategic analyses including charting and mapping, full biological and ecological studies, and full physical science analyses.
- Support facilities for high number of auxiliary spacecraft including at least two independent launch, resupply, and repair bays.
- Ability to modify all weapon systems to a high degree including variable frequency phasers, multi-mode photon torpedoes, variable pulse width disruptors, and variable geometry defensive shields.
- Provide for stealth technology including variable intensity cloaking device (installed in only Klingon variants of the design), sensor absorbent hull coatings, and a wide range of countermeasures.

Environment/Crew

- Tri-redundant environmental systems conforming to Starfleet Regulatory Agency (SFRA) standard 102.19 for Class M environment with no less than 5% habitable space of variable environmental control.
- Ability to support 800 crew and 1000 non-crew personnel for mission-specific embarkation.
- All habitable volumes to be protected to SFRA standard 347.3(a) levels for electromagnetic (EM) and nuclear radiation. Subspace flux differential to be maintained within .02 millicochranes.

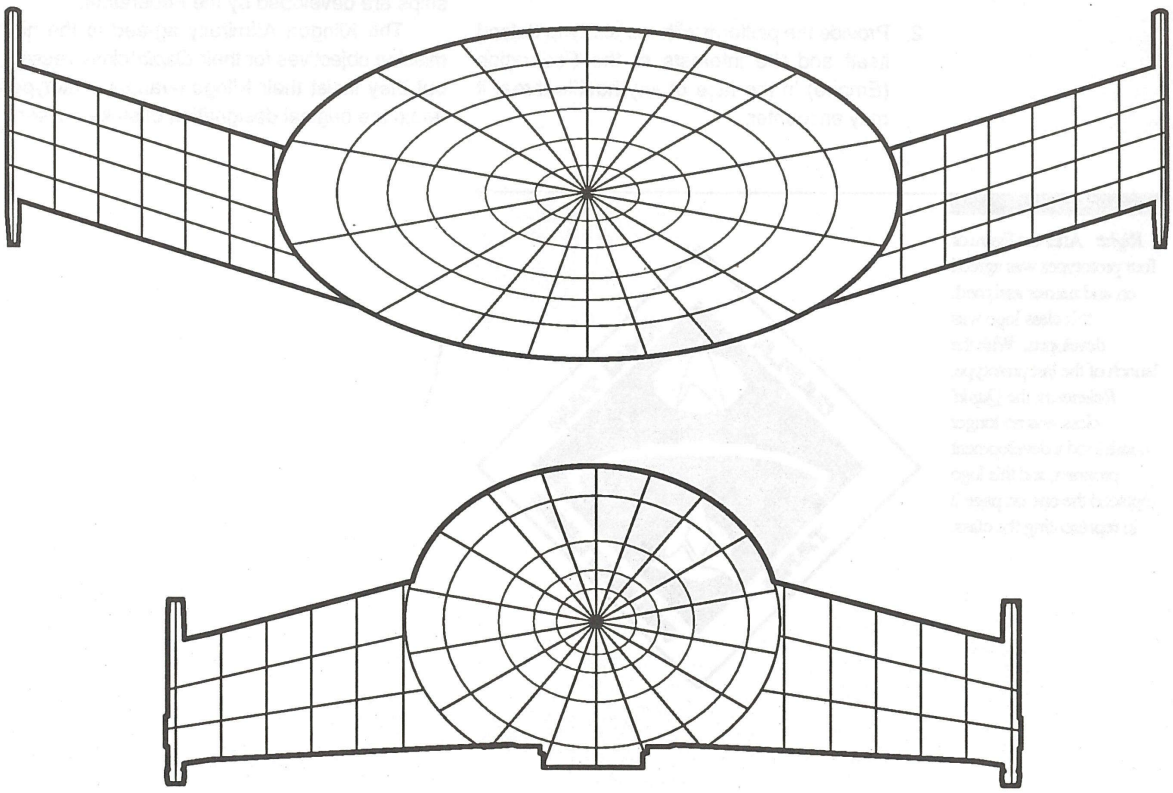
Developing an Answer

With these parameters, shipyards and computer centers began working with the design team on computer models. The saucer-wing combination showed great promise (see chapters 2 & 5), and an initial model was fleshed out to a full simulation early on.

The initial design called for a slightly larger ship that would have taken several years longer to develop and build. Fortunately, engineers at the New Aberdeen Naval Yards in the Aldebaran system suggested a design based on the two already existing *Galaxy* class primary hull frames at the Utopia Planetia Fleet Yards around Mars (the frames were completed before funding for further *Galaxy* class ships was suspended). The design team considered the advantages and the new design was polished and construction begun in record time.

Changing Threat - New Mission

Shortly before the launch of the *Khai Tam,* it was discovered that the Borg threat had been seriously curtailed. Many people now ques-



Below: Initial computer modeling showed the promise of the saucer-wing configuration. The initial design simulation (top) was significantly different, however, from the design eventually constructed (bottom). A ship of the initial design would have cost almost 60% more and would have taken twice as long to develop and build.

tioned the wisdom of the new battleship being developed by the Klingon/Federation team. Several council members even petitioned for the outright cancellation of the program.

Fortunately, the battle at Wolf 359 was still fresh in the Federation's mind and cooler heads prevailed. Work was allowed to continue on the prototypes with their performance being the ultimate test of the program. Due to political and practical considerations, however, the mission roles for the new class were modified.

The scientific and cultural facilities of the *Qapla'* class were already extensive in order to allow it to be able to perform tactical and strategic analyses by itself in outlying areas. It was decided, therefore, that with few system changes the class' exploratory role could be expanded, and the ship could be deployed in border areas where hostile encounters were possible or even anticipated.

These new goals led to the following (and current) set of mission objectives:

1. Provide an exploratory platform capable of performing preliminary survey/first contact functions in outlying unexplored regions.

2. Provide the platform with the ability to defend itself and the interests of the Federation (Empire) in the face of any hostile threat it may encounter.

3. Assure the platform is capable of rapid deployment at high warp and armed with a wide range of highly flexible weaponry that can adapt to meet the changing face of an enemy.

4. Provide autonomous capability for full execution of Federation (Empire) policy options in outlying areas.

5. Incorporate sufficient scientific and cultural research facilities for full strategic and tactical analysis and autonomous decision-making in outlying areas.

6. Equip the platform with the ability to approach a previously uncontacted or potentially hostile planet, ship, or area by stealth.

With this new set of objectives in mind, the two Federation-variant prototypes were reclassified into an entirely new category: heavy cruiser–exploratory (HC-E). Time and the ultimate success or failure of the *Qapla'* class will determine whether any further HC-E class ships are developed by the Federation.

The Klingon Admiralty agreed to the new mission objectives for their *Qapla'* class vessels, but they insist their Klingon-variant prototypes retain the original designation of strike cruiser.

Right: After the figure of four prototypes was agreed on and names assigned, this class logo was developed. With the launch of the last prototype, *Relentless*, the *Qapla'* class was no longer considered a development program, and this logo replaced the one on page 2 in representing the class.

2
Design and Construction

While not the first ship of her class, the *Khai Tam* is indeed the first ship of its kind. For although much of her construction, capabilities and design are similar to the *Qapla'*, the Federation variant of the design is very much different than her Klingon-variant sister ship.

The most notable differences between the Klingon and Federation variants are in the areas of tactical stealth and crew accommodation.

Due to the provisions of the Treaty of Algeron, the Federation was prevented from incorporating cloaking technology into its variant. The Klingons–who have used cloaking technology ever since their initially fragile and ultimately disastrous alliance with the Romulans some eighty years ago–designed a third-generation cloaking device into their variant from the very beginning (in fact, three cloaking generators were required on the *Qapla'* and *Targ* due to the width of the ships).

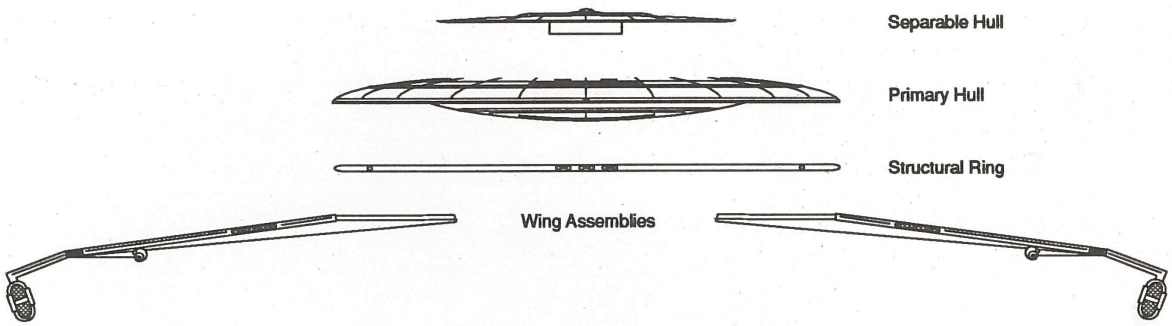
In the area of crew accommodation, the *Khai Tam* would appear very similar to the *Galaxy* or *Nebula* class, while the *Qapla'* and *Targ* more closely resemble a *Vor'cha* class cruiser. The *Khai Tam* provides spacious and comfortable staterooms, replicators with a wide range of selections, extensive recreational facilities, etc. The Klingon exchange crew of the *Khai Tam* ostensibly do not enjoy these amenities, standing by the Klingon view that they make a crew soft and undisciplined, but computer logs do show regular use of the recreational facilities by Klingon crew members.

General Physical Arrangement

In exterior appearance the *Khai Tam* is almost identical to the other ships of her class. Central to the design is a primary hull based directly on a *Galaxy* class saucer section. The reasoning behind this element of the design is entirely pragmatic: there were already two *Galaxy* class primary hull spaceframes completed and available for use when the design was conceived. For reasons of cost, support facilities, and standardization, the rest of the design was developed around this frame.

To this is added a structural ring supporting two swept wing structures which hold the warp nacelles mounted on their tips. The saucer-wing design is highly warp-dynamic when used with Klingon warp coils. The initial discovery of this fact came during the Klingon-Romulan alliance. In fact, the concept was validated initially when Klingon engineers helped implement warp drive on the Romulan bird-of-prey design during the mid 2200s. The design had never been tried before on such a large scale, however.

The warp geometry of the saucer-wing configuration requires the wings to be about as long as the radius of the saucer module. On the *Galaxy* class saucer scale, this makes each wing assembly about a quarter of a kilometer long! Considering the total wingspan and beam of the saucer, the *Qapla'* class ships are just over one kilometer wide—easily the broadest



Above: An exploded view of the major structural components of the *Khai Tam*. New Aberdeen designed and built the primary and separable hulls. Prime subcontractor K'tlah Works provided most of the wing and structural ring assemblies.

ship either fleet has ever had in service. This massive wingspan resulted in unseen benefits as well as problems.

Among the benefits are the confusing fore and stern energy profiles the ship presents. Because the nacelles are so far apart, the *Khai Tam's* energy signature is often misread by adversaries as two scout ships travelling in formation. The bow and stern profiles are also very thin height-wise, and on silent running the ship is nearly impossible to detect from the lateral aspect if the adversary is much more than 100 kilometers away. The ship is also extraordinarily maneuverable about its Y and Z axis.

The flip-side of the maneuverability issue is a slightly lower maneuverability about the X axis. This ship would also be subject to violent yaw and roll stresses if one side of the reaction control system (RCS) should fail suddenly during sublight maneuvering.

Another drawback to the width of the ship is the large torsional stress on the spaceframe. This is the reason for the massive structural ring around the bottom of the primary hull. This ring evenly distributes frame stress across the entire hull, rather than forcing the wing roots to bear all the stress. Each wing also has its own Inertial Dampening Field (IDF) and Structural Integrity Field (SIF) generators to help compensate for the strains on the wing frame.

The last drawback to the design is really one more of convenience than anything else. Due to the extreme beam of the ship, it must enter and exit most support facilities sideways, and gangways and umbilicals must be attached either fore/aft or top/bottom as few of these rigs can stretch across the breadth of the wing.

On the dorsal surface of the primary hull is a superstructure which houses most cargo spaces, the secondary shuttlebay, some living quarters, and its own independent impulse drive.

This superstructure is integrated with decks one through four (including the Main Bridge) as a separable unit from the rest of the ship. In emergencies, non-combatants may be evacuated in this section. This feature figured prominently in Starfleet's most controversial decision in the project: to allow a limited amount of family members to embark on its *Qapla'* class ships.

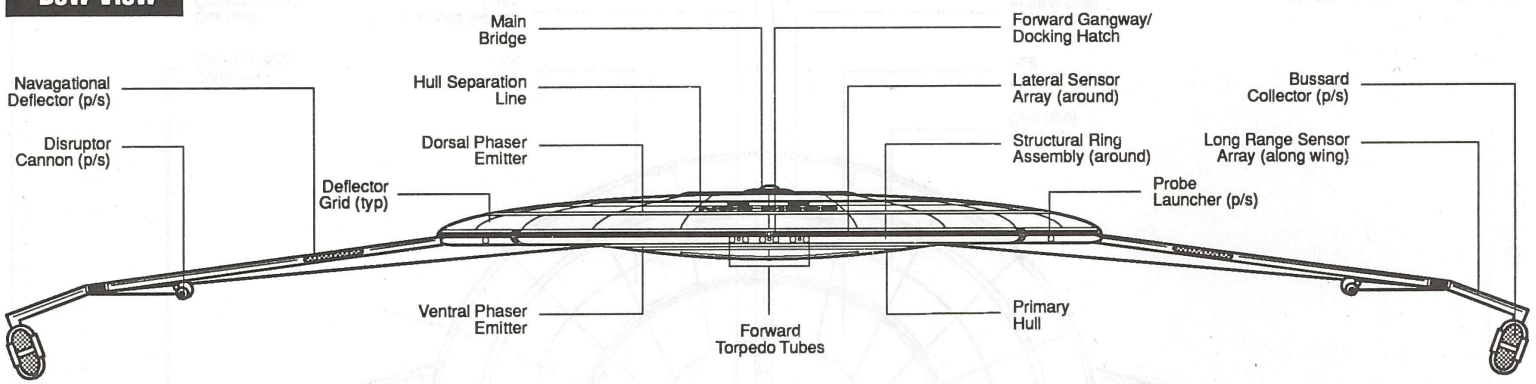
The other notable exterior features are the large shuttlebay doors on the ventral side of the primary hull. These doors enclose one of the largest shuttlebays found on any Starfleet ship short of a shuttlecarrier (see chapter 11).

The ship's eighteen decks are internally divided around major load-bearing structures. Like the *Galaxy* class saucer it is based on, the primary hull offers a great amount of internal flexibility. Entire habitation modules are inserted, making it easy to configure a *Qapla'* class vessel as either a Federation or Klingon variant.

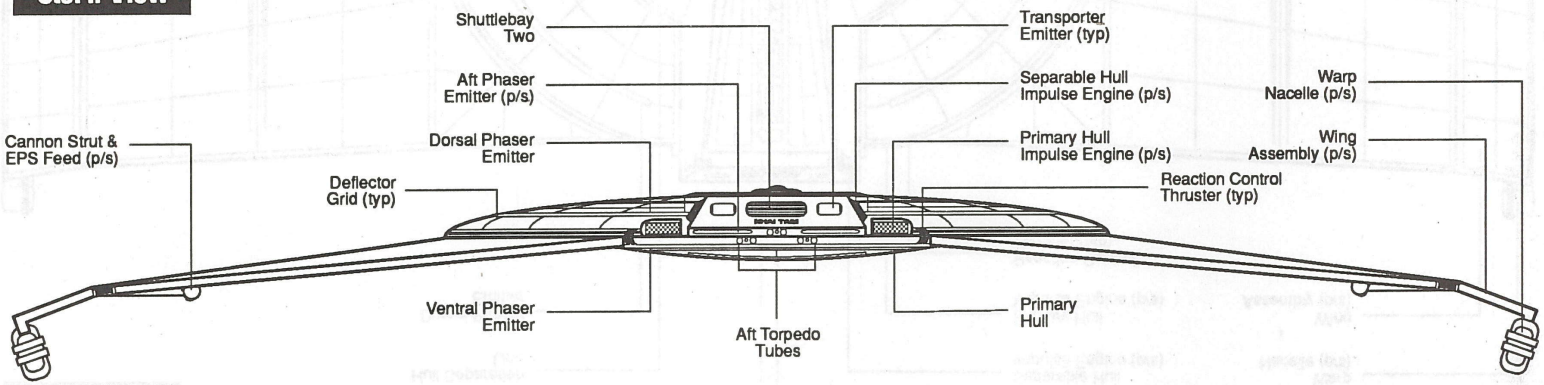
Construction Chronology

The impact of the battle at Wolf 359 caused the *Qapla'* Class Project to proceed rapidly. As a result, the first ships of the class were com-

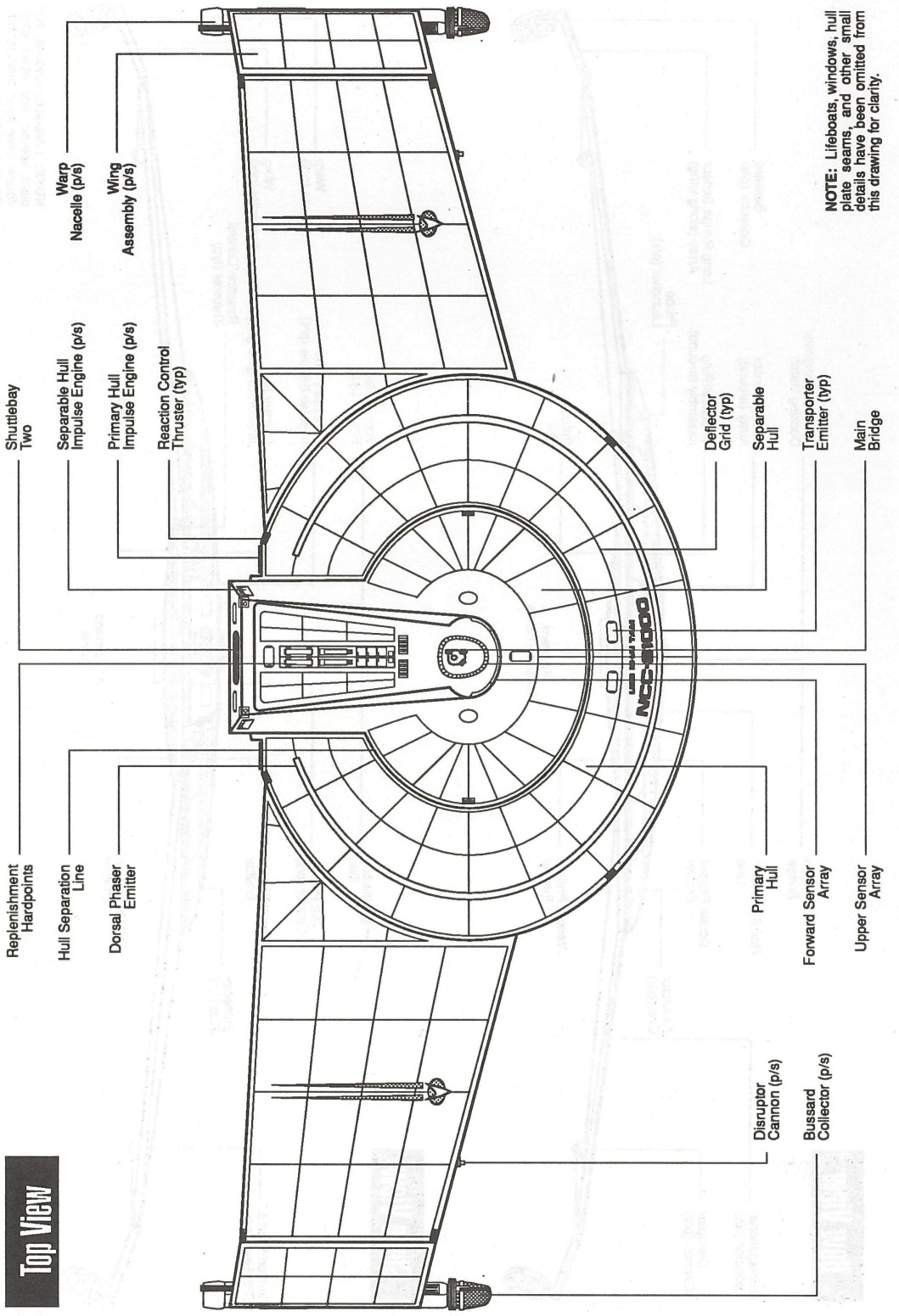
Bow View

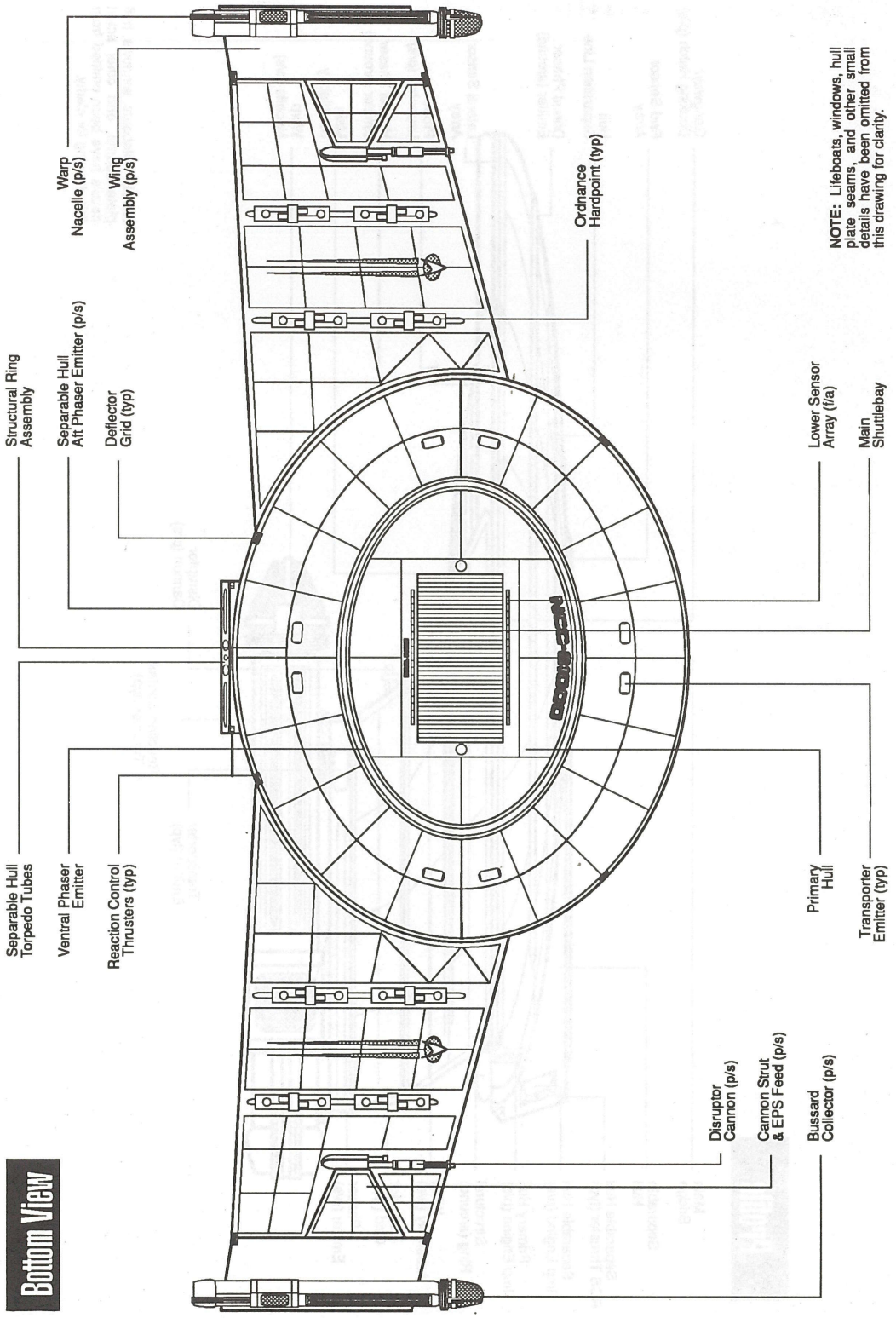


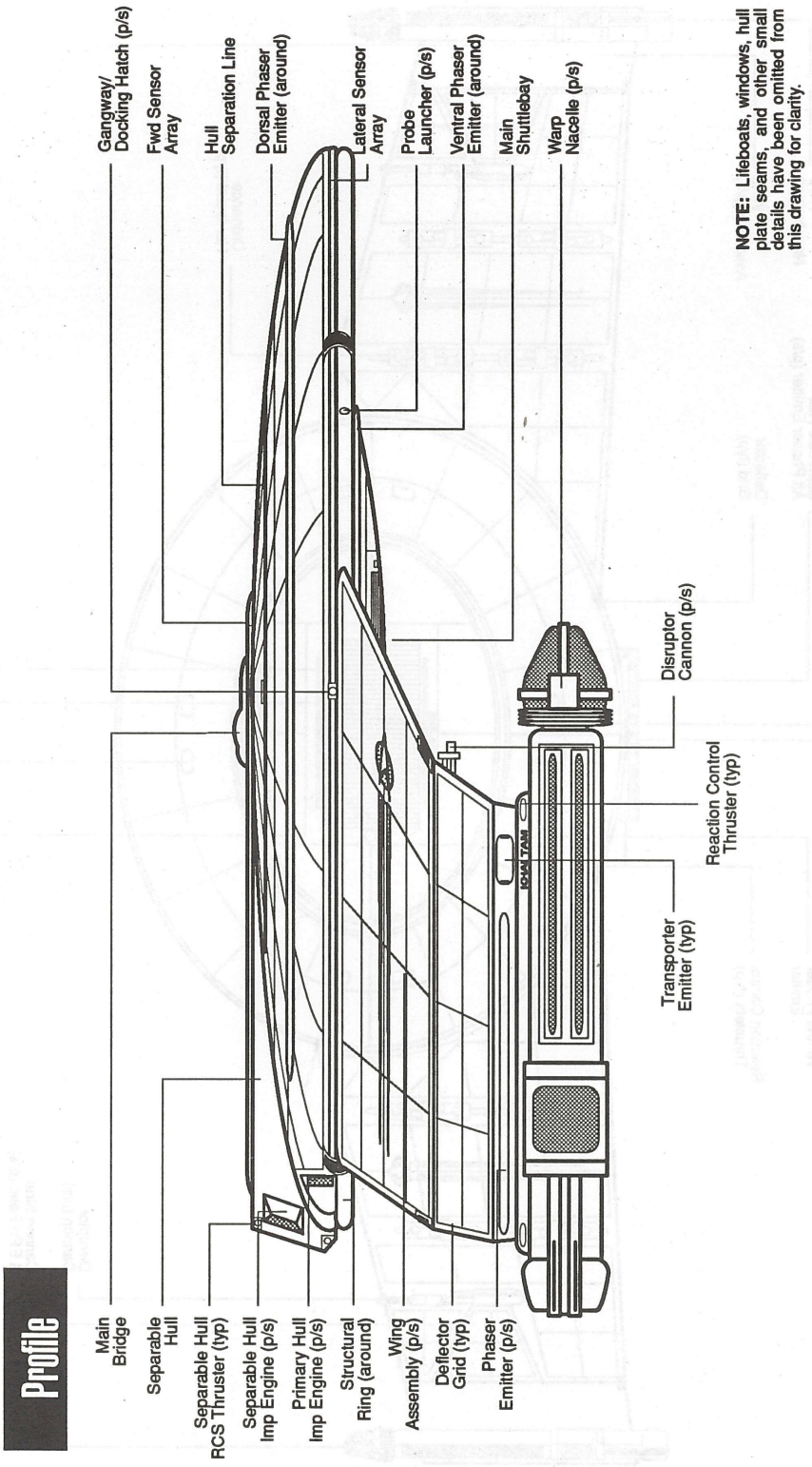
Stern View

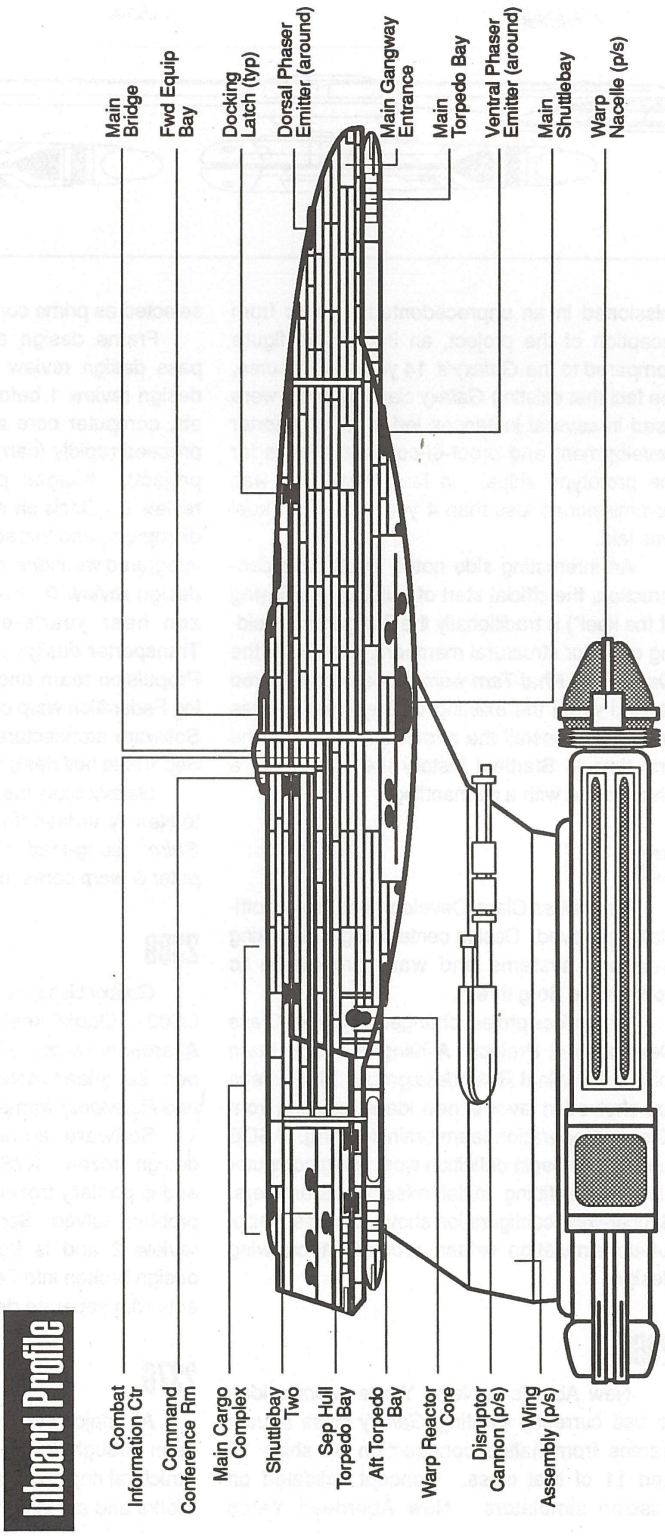


NOTE: Lifeboats, windows, hull plate seams, and other small details have been omitted from this drawing for clarity.

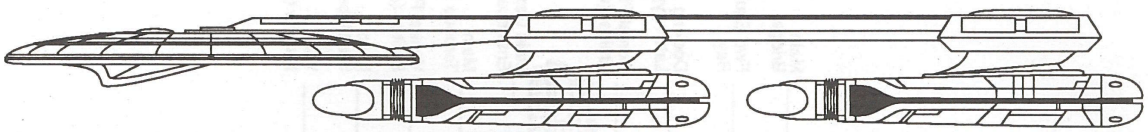

Top View
Shuttlebay Two
Separable Hull Impulse Engine (p/s)
Primary Hull Impulse Engine (p/s)
Reaction Control Thruster (typ)
Warp Nacelle (p/s)
Wing Assembly (p/s)
Deflector Grid (typ)
Separable Hull
Transporter Emitter (typ)
Main Bridge
Replenishment Hardpoints
Hull Separation Line
Dorsal Phaser Emitter
Primary Hull
Forward Sensor Array
Upper Sensor Array
Disruptor Cannon (p/s)
Bussard Collector (p/s)
NOTE: Lifeboats, windows, hull plate seams, and other small details have been omitted from this drawing for clarity.


Bottom View
Warp Nacelle (p/s)
Wing Assembly (p/s)
Ordnance Hardpoint (typ)
Structural Ring Assembly
Separable Hull Aft Phaser Emitter (p/s)
Deflector Grid (typ)
Lower Sensor Array (f/a)
Main Shuttlebay
Separable Hull Torpedo Tubes
Ventral Phaser Emitter
Reaction Control Thrusters (typ)
Primary Hull
Transporter Emitter (typ)
Disruptor Cannon (p/s)
Cannon Strut & EPS Feed (p/s)
Bussard Collector (p/s)
NOTE: Lifeboats, windows, hull plate seams, and other small details have been omitted from this drawing for clarity.


Profile
Main Bridge
Separable Hull
Separable Hull RCS Thruster (typ)
Separable Hull Imp Engine (p/s)
Primary Hull Imp Engine (p/s)
Structural Ring (around)
Wing Assembly (p/s)
Deflector Grid (typ)
Phaser Emitter (p/s)
Transporter Emitter (typ)
Reaction Control Thruster (typ)
Disruptor Cannon (p/s)
Warp Nacelle (p/s)
Main Shuttlebay
Ventral Phaser Emitter (around)
Probe Launcher (p/s)
Lateral Sensor Array
Dorsal Phaser Emitter (around)
Hull Separation Line
Fwd Sensor Array
Gangway/ Docking Hatch (p/s)
NOTE: Lifeboats, windows, hull plate seams, and other small details have been omitted from this drawing for clarity.



Inboard Profile



Above: The towing of the *Galaxy* class frames was accomplished by using one of the new *Suffolk* class heavy transport tugs, the USS *Shire* (shown above configured for her shakedown cruise in 2367). Her positionable nacelles enabled both frames to be carried in one warp envelope. Calculating the positioning of the *Shire's* nacelles took almost three weeks and in the end yielded a maximum safe speed of only warp 4.2, but it was more than adequate for the task.

missioned in an unprecedented 5 years from inception of the project, an impressive figure compared to the *Galaxy's* 14 years. Of course, the fact that existing *Galaxy* class systems were used in several instances led to much shorter development and proof-of-concept phases for the prototype ships. In fact, *Khai Tam* was commissioned less than 4 years after her keel was laid.

An interesting side note: In starship construction, the official start of building (the "laying of the keel") is traditionally the first gamma welding of major structural members. However, the *Qapla'* and *Khai Tam* were actually considered started when the existing *Galaxy* class frames were cut to install the separable hull. For the first time in Starfleet history the building of a ship started with a dismantling.

2367

Relentless Class Development Project officially approved. Design centers begin rethinking weapons systems and warp propulsion to counter the Borg threat.

Relentless project changed to *Qapla'* Class Development Project. A Klingon design team joins the original *Relentless* group. Many ideas are shelved in favor of new ideas resulting from Klingon/Federation team brainstorming. ASDB and KCWD begin definition work using computer simulations fitting initial mission parameters. Saucer-wing configuration shows promise. Initial full-up simulation written around saucer-wing design.

2368

New Aberdeen Naval Yards submits idea to use currently existing *Galaxy* class saucer frames from halted construction on ships 10 and 11 of that class. Concept validated on mission simulators. New Aberdeen Yards selected as prime contractor.

Frame design and software architecture pass design review 0 early in the year, and design review 1 before year-end. Hull materials, computer core and SIF and IDF designs proceed rapidly (carry-overs from *Galaxy* class project). Klingon propulsion systems pass review 0. Decision made to develop phasers, disruptors, and torpedo systems together as an integrated weapons system (IWS). IWS passes design review 0. Frame and hull designs frozen near year's-end, materials ordered. Transporter design passes reviews 0,1 and 2. Propulsion team encounters difficulty integrating Federation warp core with Klingon drive coils. Software architecture passes reviews 1 and 2. Separable hull design passes reviews 0 and 1.

Galaxy class frames G010 and G011 towed to New Aberdeen from Utopia Planetia by USS *Shire*. Long-lead materials ordered for computer & warp cores, nacelles, and impulse drive.

2369

Galaxy class frames renumbered Q001 and Q002. *Qapla'* keel laid in February at New Aberdeen Yards. *Khai Tam* keel laid in October. Long-lead materials ordered to build *Targ* and *Relentless* frames.

Software architecture and transporter design frozen. IWS passes reviews 1 and 2 and is partially frozen. Warp power integration problem solved. Separable hull design passes review 2 and is frozen. Habitation module design broken into Federation and Klingon variants with separate design teams.

2370

All major systems and subsystems have been through design review 2 and most frozen. Structural ring and wing frames arrive from K'tlah Works and are integrated to hull.

Skin is 65% complete. Computer cores installed. Propulsion systems 75% complete. Habitation modules begin insertion. IWS tested on static platform and design tweaked. Static warp tests reveal more problems integrating Federation/Klingon technologies. Impulse drive static test shows actual performance may exceed anticipated performance.

Discovery that Borg threat may be curtailed is made at the beginning of the year. By year's end, many begin to question the value of the *Qapla'* class.

2371

Skin is 95% complete. Computer cores are fully operational and software is debugged. Propulsion systems are installed and static tests completed. Power integration problems seem resolved. 70% of habitation modules are inserted. Holodecks and training holosuites are installed. Embarked craft are delivered.

Nothing more heard from Borg during year, dissention over project increases.

2372

Hull integrity complete; all SIF/IDF systems operational. Warp and impulse drives certified for flight. Computer and communication systems complete. IWS tested on drone targets. Habitation modules finished and recreational programs are installed and debugged.

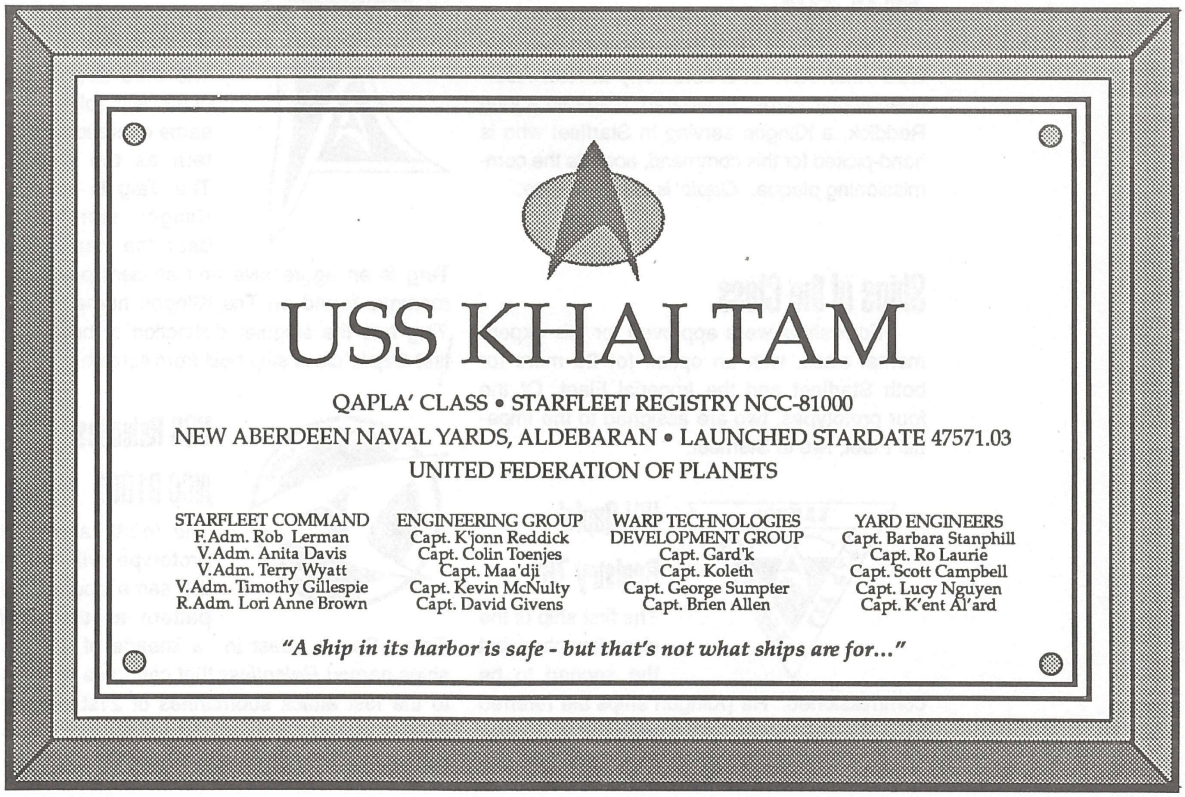
Qapla' launched in June and undergoes space trials on the perimeter of the Aldebaran system. Structural load distribution problems discovered along with new warp power integration problems. Some fixes applied directly to *Khai Tam.* Keel laid for *Targ* in December.

General agreement reached that the Borg threat has indeed been curtailed, new mission objectives established. System changes made on *Khai Tam.* Design changes made in *Targ* and *Relentless. Qapla'* requires refit.

2373

Khai Tam launched in February. Space trials show integrity of structural fixes. Dynamic

Below: The commissioning plaque accepted by Captain Reddick which is now displayed on *Khai Tam's* bridge. Note the ship's motto at the bottom.



warp tests show power integration problems minimal. Dynamic impulse tests confirm superior performance of Klingon engines. Live-fire tests of IWS show increased phaser and disruptor outputs and high torpedo yields.

Software glitches cause gravity and replicator problems which are fixed by year-end. Final hull coatings and markings applied. All lifeboats and embarked craft docked.

Qapla' still experiencing power integration and load distribution problems, combined with system refit delays her commissioning for almost a year. Keel for *Relentless* is laid in August.

2374

All ships stores loaded aboard. Full complement of crew arrive, including over 200 Klingon exchange crew. First fight breaks out in ship's lounge (considered part of commissioning by Klingons). Full complement of torpedoes loaded. Full-up shakedown cruise to Earth and back completed. Cruise reveals only minor problems which are quickly corrected en route. No major repairs/refits required in yard.

July 15, 2374

PCU *Khai Tam* is officially commissioned USS *Khai Tam* in a ceremony at New Aberdeen Naval Yards, Aldebaran. Captain K'jonn Reddick, a Klingon serving in Starfleet who is hand-picked for this command, accepts the commissioning plaque. *Qapla'* is in attendance.

Ships of the Class

Four ships were approved for this experimental class, with an option for 20 more for both Starfleet and the Imperial Fleet. Of the four prototypes, two are assigned to the Imperial Fleet, two to Starfleet.

IKV Qapla'

Registry 762

The first ship of the class launched, but the second to be commissioned. He (Klingon ships are referred to in the masculine) is named after a *K't'inga* class cruiser which served the Empire with distinction for over 30 years in the unexplored space on the border farthest from the Federation. He is assigned to the Imperial Fleet and carries a mixed crew of approximately 75% Klingons and 25% Federation Exchange Crew in one year rotation. He operates in Klingon space under the direction of the Klingon Admiralty.

USS Khai Tam

NCC 81000

The second ship of the class to be launched and the first to be commissioned, the *Khai Tam* is assigned to Starfleet. She is named for the first warp-capable vessel produced by Earth's Asian Coalition in the late 21st century ("khai tam" is Old Earth Vietnamese for "brave heart"). She carries a mixed crew of approximately 75% Starfleet personnel and 25% Klingon Exchange Crew in one year rotation. She operates primarily on the edge of Federation space under the direction of Starfleet.

IKV Targ

Registry 763

The third ship of the class will follow the same operational pattern as the *Qapla'*. The *Targ* is the first Klingon starship to bear the name (the Targ is an aggressive and efficient predatory mammal found on The Klingon home world). *Targ* has the singular distinction of being the first *Qapla'* class ship built from scratch.

USS Relentless

NCC 81001

The fourth and final prototype will follow the same operational pattern as the *Khai Tam*. She is latest in a lineage of notable ships named *Relentless* that can trace its roots to the fast attack submarines of 21st century Earth's United Kingdom. She is the third Starfleet vessel to bear the name.

3
Command Systems

The *Khai Tam* has two major nerve centers. Not only is there the Main Bridge (which supervises most operations in cruise mode), but there is also the Combat Information Center (CIC). More than a Battle Bridge, the CIC is the core of tactical intelligence and combat operations aboard. While in many emergency situations a red alert will find the Captain on the bridge, a call to battle stations will invariably result in the Captain transferring command to CIC as a matter of course.

Main Bridge

Under most circumstances, command of the *Khai Tam* will rest with the Captain or Officer of the Deck (OD) on the Main Bridge. The Main Bridge is located atop the primary hull on deck 1, and externally resembles its *Galaxy* class cousin as a replaceable module. Internally, however, the arrangement is substantially different. Because she was originally designed as a defensive platform, the *Khai Tam's* bridge layout is heavily influenced by Klingon design. The Klingons, after all, have the expertise in combat operations command and control. This Klingon influence has resulted in a bridge that is extraordinarily efficient and practical, and a design aesthetic that defines the character of the vessel as a Klingon-Federation hybrid. More than any other space aboard, the bridge establishes the ship's "personality".

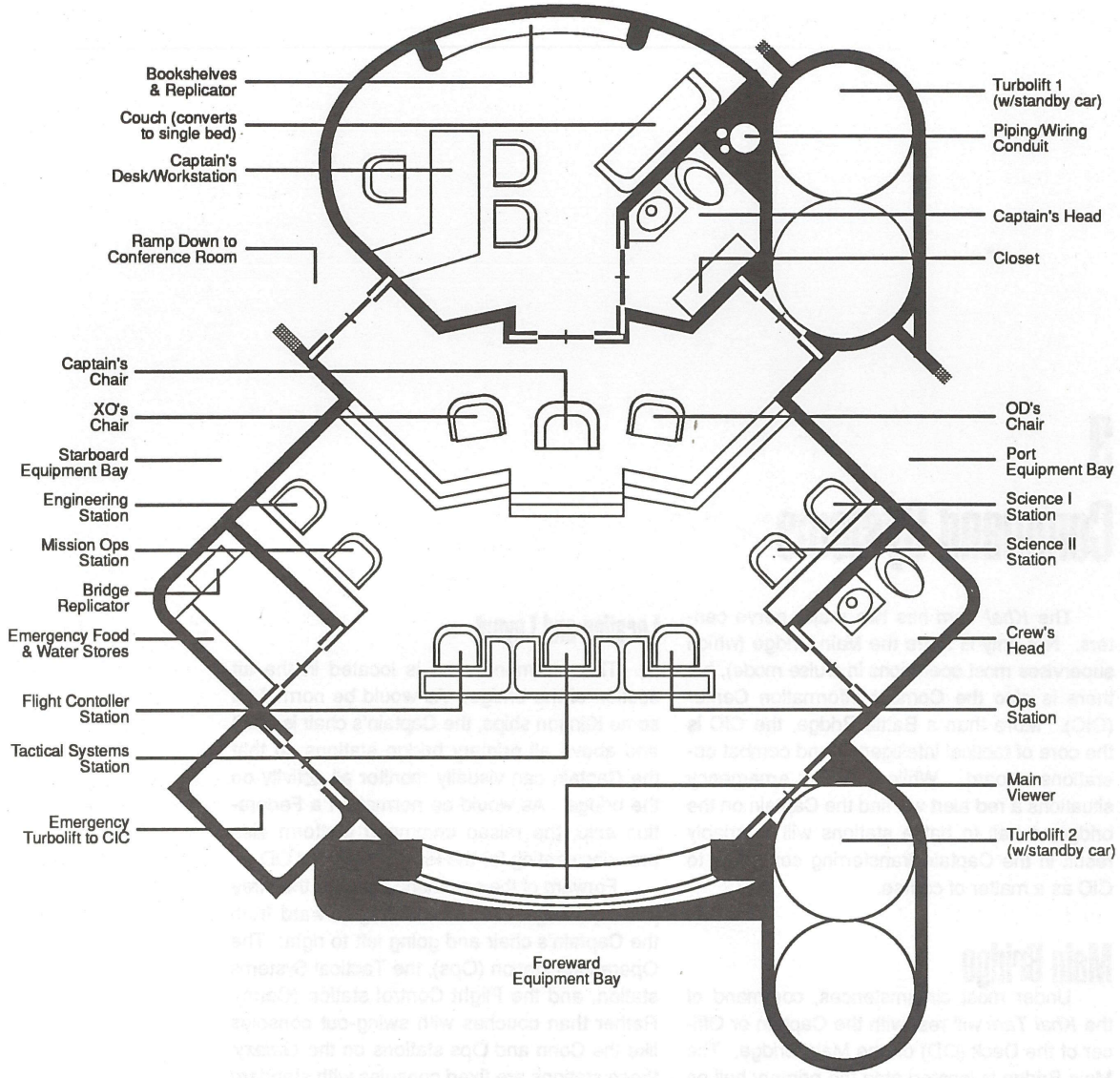
Location and Layout

The command area is located in the aft section of the bridge. As would be normal on some Klingon ships, the Captain's chair is abaft and above all primary bridge stations so that the Captain can visually monitor all activity on the bridge. As would be normal on a Federation ship, the raised command platform also provides seating for the First Officer and OD.

Forward of the command area are the three primary bridge stations. Facing forward from the Captain's chair and going left to right: The Operations station (Ops), the Tactical Systems station, and the Flight Control station (Conn). Rather than couches with swing-out consoles like the Conn and Ops stations on the *Galaxy*, these stations are fixed consoles with standard seats.

To the Captain's left are the port-side bridge stations, normally configured as Science I and II. Usually only one console is manned, but another is available to meet mission requirements or emergency needs. To the Captain's right are the starboard-side bridge stations normally configured as Mission Ops and Engineering. Emergency environmental control (which has its own console on many ships) is handled through the Engineering station.

At the far forward end of the compartment is the large main viewer. The holo-capable display matrix is the same as that used on the



Above: A floor plan of the *Khai Tam's* Main Bridge. Note the angular layout reminiscent of a Klingon bridge. However, it is decorated with carpet and wall coverings bowing to the Starfleet aesthetic.

Galaxy and *Nebula*. Behind the viewer is the forward equipment bay that houses the subprocessors, optical data network (ODN) trunks and other utilities dedicated to the bridge. Several other subprocessors and utility feeds are housed in smaller equipment bays on the port and starboard sides.

Workstations

Like the *Galaxy*, the *Khai Tam* makes use of software-defined, touch sensitive workstations for all consoles. The software-defined panel is just coming into use in the Imperial Fleet, so much of the panel design was left to Federation engineers who, in turn, relied heavily on the work of those before them. In construction, the panels are virtually identical to their Starfleet counterparts, although a slightly more sensitive tactile matrix is used which results in fewer input errors and re-tries.

The console at each station can be defined by the user on an ongoing basis to provide them with an optimal working interface (see

illustration at right for an example). At shift change, a crew member simply sits down at the console and states their name and latest saved panel design, and the computer reconfigures the display. When the ship is on alert, all stations return to their default layout so any bridge crew member can operate any panel effectively.

The command chairs have smaller displays built into the arm rests. The display pulls up from the right arm rest and folds over the lap of the seat occupant. This serves three functions: it allows for a larger console display than on most command seats, it can double as a desk/table, and it helps restrain the seat occupant during partial IDF failures.

Captain's Ready Room & Other Facilities

Abaft the walkway behind the Captain's chair is the Captain's ready room and head. The ready room serves several important functions. Primarily, it serves as the Captain's office, but it also serves as a small, private conference area. It is equipped with a replicator and a couch which converts to a single bed so that the Captain can effectively live here in a crisis situation so that he never has to leave the bridge (the head even has a closet for fresh uniforms).

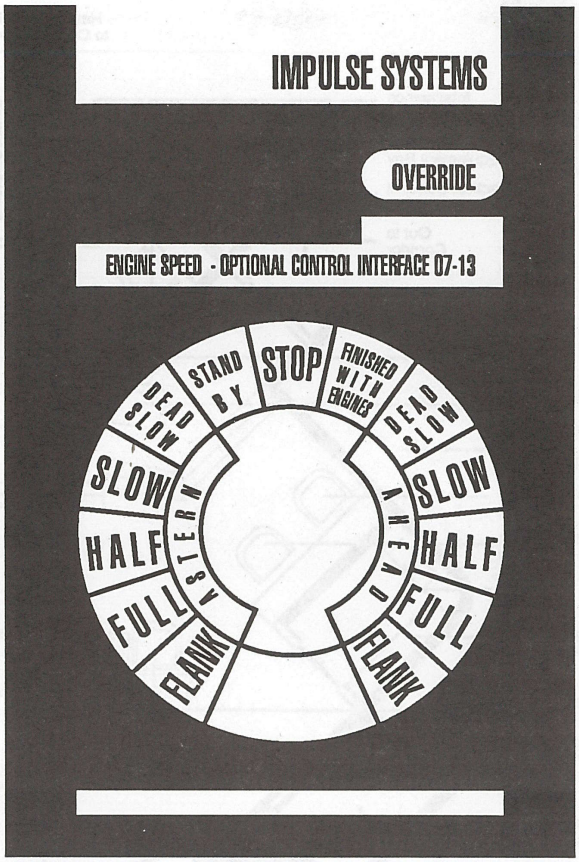
Abaft the ready room is the Command Conference Room (conference room 1). Actually, the conference room is half a level down from the bridge, but is still considered to be on deck 1. Other facilities on deck 1 include the crew's head, a replicator and emergency supply of food and water, emergency dedicated life support to the bridge (48 hour supply), two turbolifts, and an emergency turbolift directly to CIC (an emergency ladderway extends the length of the shaft on its interior surface to provide access to CIC in the event of turbolift failure).

Main Bridge Operations

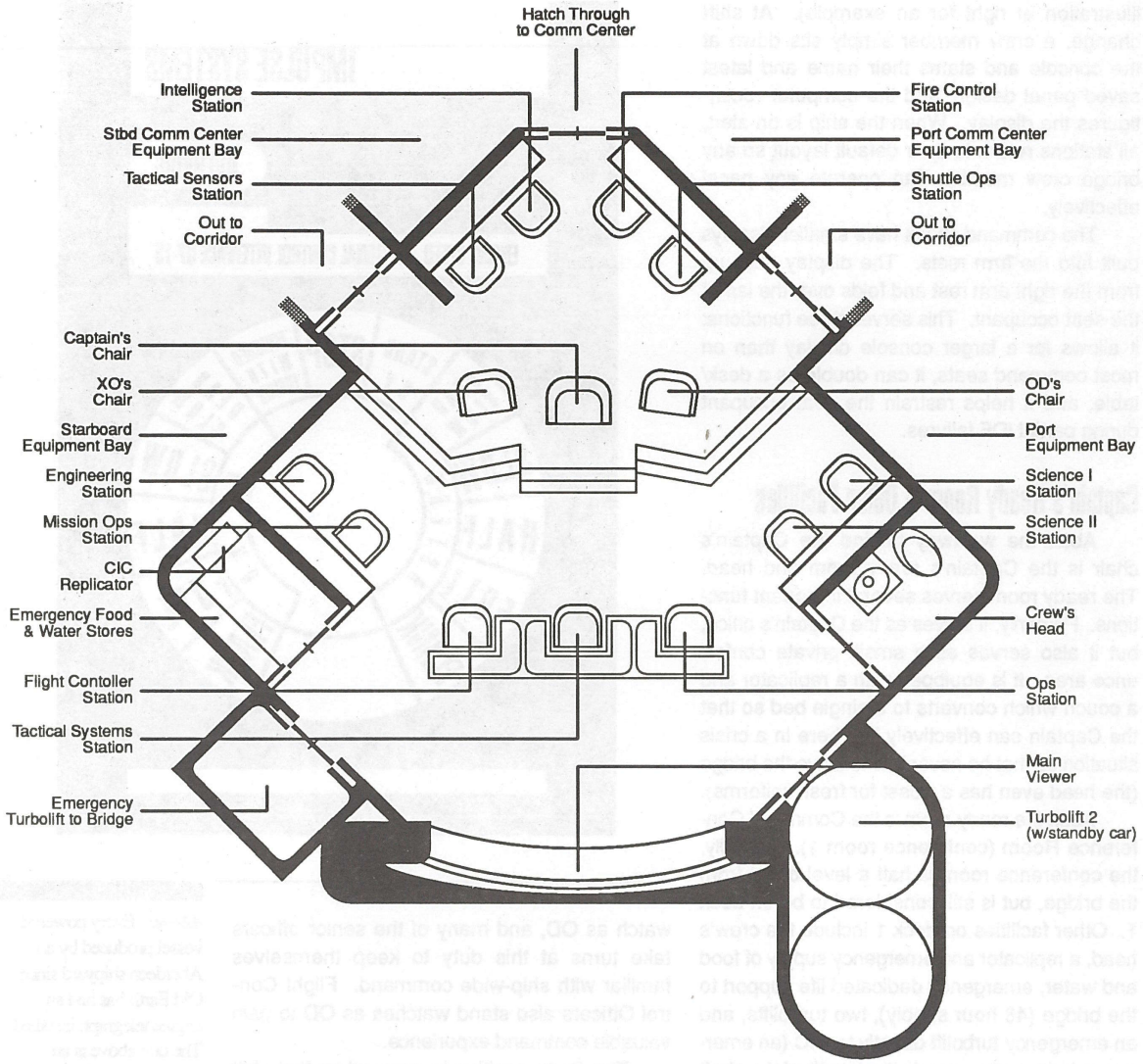
Under normal cruise mode, the Captain or OD commands the ship from the Main Bridge. Even when the Captain is on the bridge, there is an OD on duty. Often times, the Captain will be on the bridge but leave command of the ship to the OD while the Captain reviews tactical data or simply sits back and evaluates the OD's performance. When the Captain is on duty but in the ready room, the OD has command of the ship. Any line officer may stand watch as OD, and many of the senior officers take turns at this duty to keep themselves familiar with ship-wide command. Flight Control Officers also stand watches as OD to gain valuable command experience.

The Conn position is manned on first shift by the Navigation Officer. On second and third shifts, Flight Control Officers man the position. Similarly, The Ops station is manned by the Operations Manager on first shift, and by Ops Watch Officers on second and third. The Tactical Systems station is manned by the Chief of Security on first shift, the External Security Officer on Second shift, and the Internal Security Officer on third shift.

The port and starboard stations are only manned as needed, although there is usually someone at Science I on all three shifts. Mission Ops is manned by a Resource Allocation Specialist during critical primary or secondary missions. Engineering is normally manned only



Above: Every powered vessel produced by an Aberdeen shipyard since Old Earth has had an engine telegraph installed. The one above is an optional control surface programmed into the Flight Controller's console on the *Khai Tam.* Although installed primarily as a bow to tradition, the interface has actually proved quite popular among Klingon Flight Controllers who are accustomed to not having fine speed control over their impulse engines.



Above: A floor plan of the *Khai Tam's* Combat Information Center (CIC). Except for the aft section, it is an exact duplicate of the Main Bridge. This increases efficiency of personnel who must interchange workstations between the two locations.

during alert situations to provide the bridge with critical ship status information in a crisis.

When the ship is on alert status of any kind, all bridge stations are manned and fully functional. Each officer or specialist verifies that all alert protocols under their supervision have been carried out and that all systems are at the appropriate readiness level. Diagnostics of a level commensurate with the current alert level are performed by each station. The personnel with assigned bridge alert stations varies with mission requirements and watch schedules.

On any type of alert other than battle stations, the Captain will usually go to the Main Bridge. During battle stations or if the separable hull is to be detached, the Captain will usually transfer command to CIC.

Combat Information Center

CIC is located in the center of the primary hull on deck 8—one of the best-protected areas of the ship. Its layout is the same as the Main Bridge with the addition of four stations behind the Captain's chair facing astern and going left

to right: Tactical Sensors, Intelligence, Fire Control, and Shuttle Ops). There is no ready room or conference area.

Dedicated utilities, subprocessors, and life support are housed in large equipment bays to port and starboard. In place of the bridge's turbolift 1 and conference room ramp, CIC has corridor access. Turbolift 2 and the emergency bridge turbolift occupy the same positions.

CIC Operations

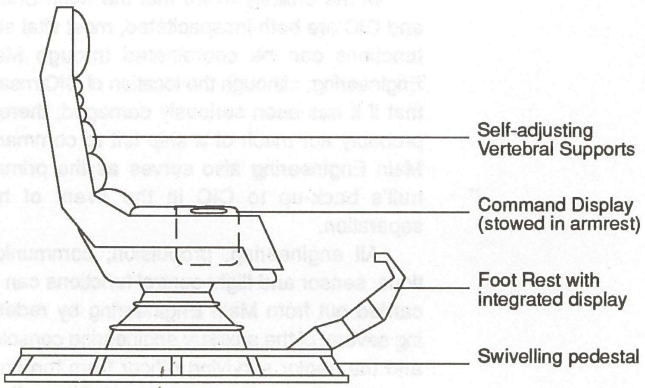
The staffing plan for CIC is different than the Main Bridge. Under normal cruise mode, the CIC is operated under the command of the Tactical Systems Officer (TSO) or the designated watch officer (usually the Gunnery Officer on mid watch and the Torpedo Officer on night watch). This officer sits at the Tactical Systems console in CIC. The command area is usually empty during normal cruise mode.

The Conn position is staffed by a Flight Control Officer, although under normal cruise mode flight control rests with the Main Bridge. The Flight Controllers assigned to CIC, therefore, spend much of their time performing diagnostics, simulations, and administrative tasks. The Ops position is unmanned in normal cruise mode.

The Tactical Sensor and Intelligence consoles are manned by Tactical Sensor Specialists on all three shifts and the Fire Control station is similarly manned by a Fire Control Specialist on each shift. Tactical analysis of incoming sensor data is the primary function of CIC under normal cruise mode. These specialists keep the Tactical Systems Officer apprised of intelligence and target information, and the TSO in turn keep the Security Officer on the Main bridge informed.

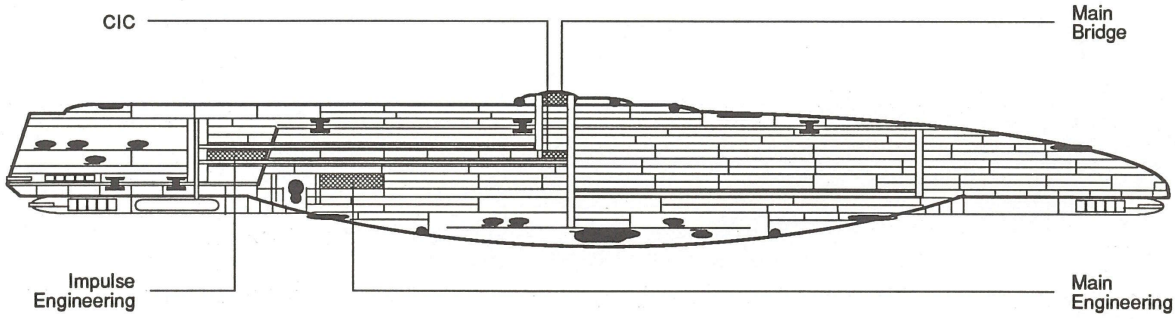
The port and starboard CIC stations are normally unmanned during normal cruise mode, but they can be used for running diagnostics and/or simulations so that the bridge stations are not tied up with these processes. It is not unusual for one of these stations to go unused for days at a time, although the CIC Science stations are sometimes manned by secondary mission specialists when ship-wide control of non-critical systems is desired.

When the ship is on alert, all stations in CIC are manned and made fully operational. If the Captain chooses to retain command on the Main Bridge, a senior officer is dispatched to CIC to take the command position (usually the Executive Officer). Weapons Control may in part or whole be transferred to CIC.



Above: The Captain's Chair is a popular Klingon design which incorporates a course/speed/position display in the foot rest. The chair was modified to accommodate the armrest command display.

Below: Primary hull cross-section highlighting the four primary command areas. Note how well protected CIC is. Should it be incapacitated, there would likely not be much of a ship left to command.



Main Engineering

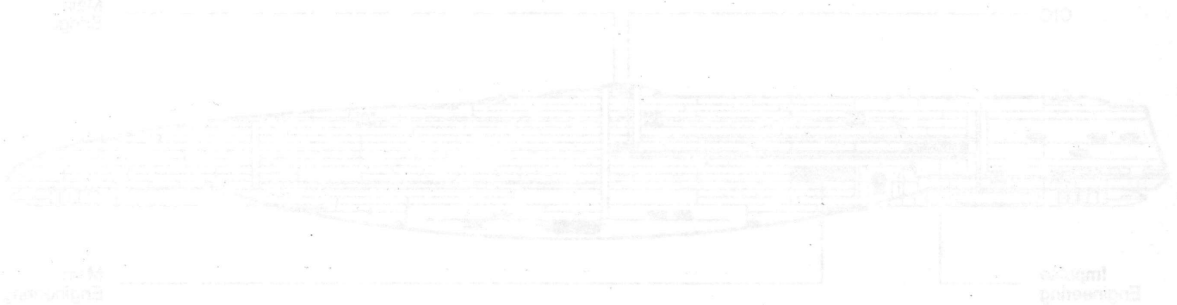
In the unlikely event that the Main Bridge and CIC are both incapacitated, most vital ship functions can be coordinated through Main Engineering; although the location of CIC means that if it has been seriously damaged, there is probably not much of a ship left to command. Main Engineering also serves as the primary hull's back-up to CIC in the event of hull separation.

All engineering, propulsion, communications, sensor and flight control functions can be carried out from Main Engineering by redefining several of the auxiliary engineering consoles, and the senior surviving officer from the command staff reports here if possible. If no command staff member reports, the Chief Engineer assumes command. Weapons control is usually transferred to the main torpedo bay. Shuttle operations control is transferred to Primary Flight Control or shuttlebay 2.

Impulse Engineering

In the event of hull separation, Impulse Engineering serves as the back-up to the Main Bridge. The operational scenario would look much like the Main Engineering scenario above. Weapons control would be transferred to torpedo bay 3. Shuttle Ops would be transferred to shuttlebay 2.

When the ship operates in its normal docked configuration, Impulse Engineering serves as the back-up engineering command to Main Engineering.



4
Computer Systems

If the warp engines are the heart of a starship, the main computer is its brain (or more appropriately one hemisphere of its brain with the crew being the other). Almost nothing aboard the *Khai Tam* (or any modern starship for that matter) will operate without some degree of computer control. This fact makes the computer system arguably the most important single system aboard.

The computer system used on the *Khai Tam* is based on computer cores taken directly from the *Galaxy* class program, so most of the related hardware and software is Federation-designed. The Klingon contribution in this area is limited to software architecture (especially of weapons systems) and slave processor technology.

Due to its *Galaxy* class base and the fact that as a Federation vessel it must interface with all Starfleet databases, the *Khai Tam's* computer system uses the standard LCARS (Library Computer Access and Retrieval System) interface. Both voice or keypad inputs are accepted at most terminals (a few terminals are keypad-only), and headsets are available for vocal inputs and audio outputs in high background noise environments. The LCARS system is a intuitive artificial intelligence-based system that is extremely user-friendly, even Klingon exchange crew members have commented on its ease of use. The Klingon-variant ships of the class have so increased efficiency with LCARS over standard Klingon interfaces that the Imperial Fleet is studying the possibility of developing a similar system for its own use.

Cores

At the center of the computer system are the two redundant computer cores and separable hull "mini-core" that house most of the memory and processing functions of the system. The two primary cores are duplicates of the cores used in the *Galaxy* class in structure and size, and they occupy the same position

Below: If one of the primary cores is down for any reason, many disappointed crew members may find the "temporarily unavailable" message on holodeck, library or replicator terminals.

Recreational Program Database **HOLODECK 1**

Due to a reallocation of computer resources, this terminal is temporarily unavailable.

within the spaceframe (port and starboard near the center of decks 5 through 14). These locations are two of the best protected from battle damage, and the *Galaxy* class spaceframes used in the construction of the *Qapla'* and *Khai Tam* already had the proper structural configuration to accommodate the cores.

The only difference hardware-wise between the *Qapla'* and *Galaxy* cores is in the improved memory capacity and faster-than-light (FTL) processing capability of the newer cores. These units are scheduled to be retrofitted in the *Galaxy* class ships in the next few years.

Either of the two primary cores is capable of handling all of the ship's normal data functions by itself if need be, but usually the load is evenly distributed. If one core must take on sole responsibility for the system, some recreational functions may be shut down to retain system speed.

A smaller "mini-core" in the separable hull is capable of handling all of that hull's key functions in the case of hull separation. It can run the entire ship's most critical systems in case of total primary failure, but many secondary systems (including replicators and waste recovery units) must be shut down completely in order for it to handle the load.

The mini-core is comprised of only three levels (two primary and one upper) and resides just off the centerline near the main cargo complex on decks 2, 3 and 4.

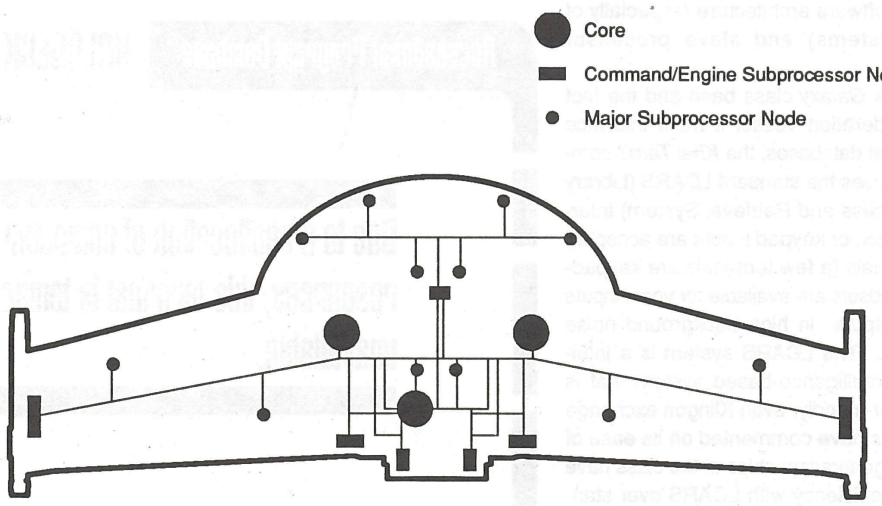
Core Memory & Processing Capability

Processing speed gains in the new cores were accomplished essentially by fine-tuning the miniature subspace field generators to increase their output to 3400 millicochranes (versus the old figure of 3350). This seemingly slight increase has resulted in a logarithmic increase in FTL processor speed.

The "tweaking" of the subspace field generators also resulted in a slightly more efficient transmission rate across the micron junction links (MJLs) which bridge the subspace boundary layer. A drop of nearly one percent in transmission loss resulted from the fine-tuning, bringing the total figure for Doppler loss to only 11%.

This increase in FTL processing capability presented two options: Either the overall processing speed could be increased over previous versions, or some of the core space previously dedicated to FTL processing could be reallocated to memory storage—leaving the core with a processing capability equivalent to its previous version.

In the case of the *Khai Tam* the choice was clear: memory. While the increase in memory modules may not seem significant (2,280 versus 2,048), the additional 232 modules provide an extra 146 million kiloquads of memory. This enables the cores to accommodate the Klingon databases required for the



Below: An overly simplified schematic showing the core and major subprocessor networks. The separable hull's mini-core (large circle aft) had to be placed off the centerline due to the ship's replenishment system (see chapter 8).

hybrid technology aboard (not to mention the Klingon recipes for the food replicators).

Subprocessors & Slave Processors

Even though the complexity of systems aboard the *Khai Tam* are roughly comparable to her *Galaxy* class cousins, the number of subprocessors aboard is significantly less. Only 200 quadritronic optical subprocessors are used on board versus 380 on the *Galaxy*. The decrease in subprocessors is the result of two important system features. First and foremost, the separable hull of the *Khai Tam* is nowhere near the size of the *Galaxy's* battle section, so many of the full system redundancies in that ship are not present in the *Khai Tam*.

Another important difference between the two systems is the incorporation of slave processors which are used extensively in Klingon computer systems. While subprocessors are stand-alone computers that can function independently of the main core if needed, slave processors are smaller units which simply carry out commands of the subprocessor and relay data to and from it via I/O devices.

The slave processors help relieve the load of the subprocessors significantly. Rather than have, for example, a torpedo control subprocessor (TCS) which handles datalinks, target information, warhead loading, etc., for an entire torpedo bay, the TCS merely coordinates and commands the activities of the slave processors at each tube. This significantly reduces the workload of the subprocessors, meaning less are needed. Of course, many slave processors are needed (almost 200 are used aboard the *Khai Tam*), but their use decentralizes computer operations so that damage to any one slave processor does not compromise an entire subprocessor link.

Datalinks

The cores, subprocessors, slave processors, and I/O devices aboard the *Khai Tam* are all linked via the Optical Data Network or ODN. This network of fiber optic cable runs throughout the entire ship, reaching everything from the aft nacelle RCS packages to the forward gangway hatch controller. Most ODN trunks run through Jeffries Tubes or corridor panels for easy access, although those that link critical or secure systems are usually run through protected conduits (see chapter 7 for more information on the ODN).

Redundancy to the ODN links is provided by a dedicated network of short-range radio frequency (RF) links, providing emergency data communications with the Main Bridge, CIC, Main Engineering and Impulse Engineering. A separate set of short-range RF links are dedicated to data transfer with hand-held devices like PADDs and Tricorders.

One more layer of redundancy is built into the system with an old Klingon stand-by: a network of wire connections to carry digitized electronic impulses. This is a much slower system than the ODN or RF connections, but it is highly reliable and damage-resistant. The network connects only the most critical of the ship's systems and is used only as a last resort. This hard-wired system is found on almost all Klingon vessels and has proved its worth several times over the last fifty years.

Datalinks external to the ship are set-up by the Communications Department. See chapter 8 for more information.

5
Propulsion

The propulsion systems of the *Khai Tam* are indeed hybrid systems. The most important goal of the hybrid technology program—the combination of a Federation warp core and Klingon nacelles—proved to be the most trying and most rewarding phase of the program. The use of Klingon impulse drive hardware controlled by Federation engine control routines was another tricky marriage. In the end, however, the hybridization paid off.

Warp Propulsion

The design of the warp propulsion system (WPS) for the *Qapla'* class was possibly the most difficult, and most successful synthesis of Federation and Klingon technologies in this joint-technology vessel. The joint-design team had to overcome many obstacles in the development of this, perhaps the most critical system on board.

The first difficulty arose in the basic design of the ship: how to incorporate elements of both civilizations' fundamental design strategies into the ship, and still allow it to be warp-feasible. Computer modeling at the Daystrom Institute of Technology and at similar centers in the Klingon Empire showed that the saucer-wing configuration would be, theoretically, the most viable design. This model was submitted to the design team, and, with a few minor changes, went on the drawing board as simulation QX-0001, *Qapla'* Class Development Project.

The second problem then arose: the warp field dynamics proposed by the computer models were not feasible by using either technology alone. Both sides brought in their top experts in warp propulsion, subspace theory, and related fields to attack the problem. Finally, a Klingon team provided the answer through the introduction of a third source: Romulans.

Many years ago, the Klingons had given the Romulans warp technology during their ill-fated alliance. A Klingon team had developed warp dynamics equations to fit the highly successful Romulan "Bird of Prey" vessels which were essentially a saucer-wing design. Preliminary modeling by the Klingon *Qapla'* team showed that incorporation of the old Romulan warp field configuration might provide the warp dynamics necessary for the *Qapla'* class.

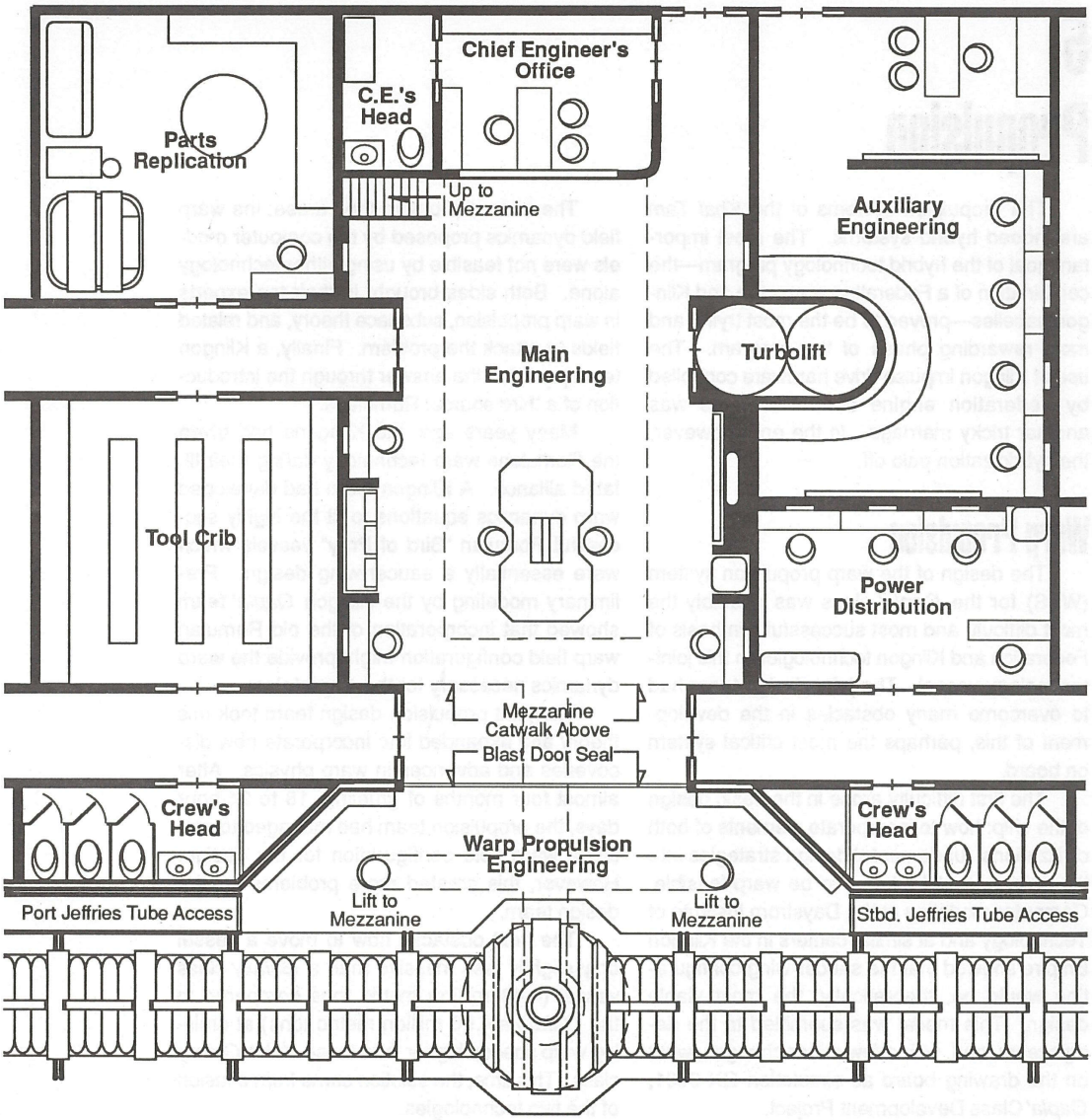
The joint propulsion design team took this theory and expanded it to incorporate new discoveries and advances in warp physics. After almost four months of grueling, 18 to 24-hour days, the propulsion team had managed to create a warp field configuration for the design. However, this created more problems for the design team.

The next obstacle: how to move a vessel only slightly less massive than a *Galaxy* class vessel (4.43 million metric tons compared to the *Galaxy's* 4.96 million metric tons) at cruising warp speeds higher than those of the *Galaxy* class. This time, the solution came from a fusion of the two technologies.

Below: A floor plan of *Khai Tam's* Main Engineering complex clearly shows the unique horizontal orientation of the M/ARA assembly. The ship simply isn't thick enough in draft to use a vertically oriented assembly.

While both technologies were capable of providing similar warp speeds, each technology did so in a different fashion. The lack of quality dilithium crystals and inferior matter/antimatter purification techniques served to inhibit the Klingon engines, dictating that they develop superior driver coils, which are capable of more rapid plasma injections and of providing better warp field stability than the Federation top-of-the-line engine could. The Federation engines have access to higher-quality dilithium and antimatter, but not quite as strong driver coils. The combination of the two technologies allowed the engineers to meet the propulsion requirements set out in the *Qapla'* class design goals.

Again, however, this systems integration proved to be difficult. The design team not only had to write an almost entirely new computer program to control the plasma injector systems, they had to redesign the injector system itself to enable the Federation plasma transfer conduits to coordinate with the Klingon driver coils.



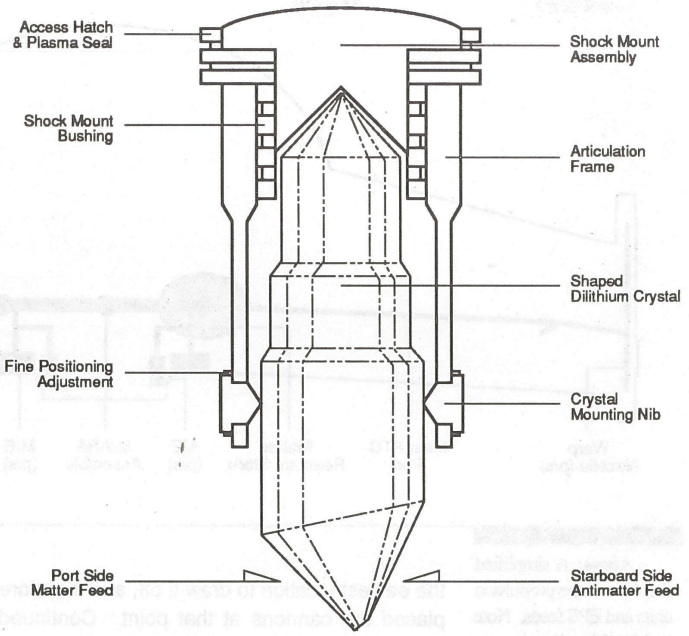
This particular component of the WPS continued to plague the engineers throughout the design of the vessel, causing delays in the commissioning of the *Qapla'* for almost a year due to power system integration problems. In its space trials, *Qapla'* could only reach Warp 5.2 before resonances from the driver coils would, as one test engineer described it, "threaten to shake us all to pieces." Programming changes in the plasma injector programs along with a slight redesigning of the injectors themselves managed to prevent the resonances, and enabled the ship to reach its original design specifications.

One added bonus did come out of this design, though. Because of the placement of the engines and the vessel's angled-wing design, there exists a large empty space underneath the saucer section in the warp envelope. This space is not exceptionally large, but would enable the *Khai Tam* to keep a deployed runabout or shuttle inside her warp envelope without seriously affecting her performance. While this theory looks promising, a practical test has not yet been attempted.

Matter/Antimatter Reaction Assembly

In a warp propulsion system so extensively redesigned, the matter/antimatter reactant assembly (M/ARA) is remarkably untouched. The only major difference from the *Galaxy* class to the *Qapla'* class is that in the *Qapla'*, the assembly is horizontal. It is located entirely on Deck 12, with the matter reactant injector to port, and the antimatter reactant injector to starboard. In the warp core itself, the dilithium crystal assembly is mounted in the "ceiling", and is accessible for maintenance only from the Main Engineering mezzanine catwalk.

This rather unusual configuration is due to the fact that the shallow draft of the primary hull made it nearly impossible to install the M/ARA vertically in the *Qapla'* class. Therefore, the design team developed the idea of installing it horizontally in the portion of the new design which corresponded to the old docking latch area in the *Galaxy* class saucer section. This placement allows for explosive ejection of the M/ARA through the bottom of the hull in extreme emergencies. This did, however, require some interesting designing of the power transfer conduits to get the energized plasma to the warp nacelles.

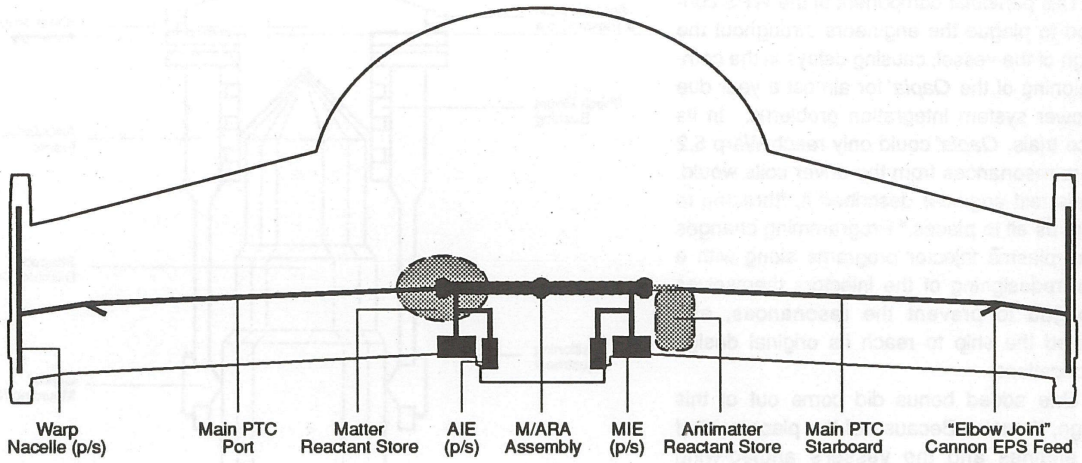


Above: A cross-section of the dilithium crystal articulation frame. This is precisely how the crystal "hangs' in the horizontal warp core.

Power Transfer Conduits

The power transfer conduits (PTC) run down from the matter/antimatter reaction chamber, then split between Decks 13 and 14 to run out to the wings, and then on to the nacelles. (See diagram next page.) The conduits are identical to standard *Galaxy* class PTCs, both in material composition and construction. In the event of an emergency in which the warp core must be jettisoned, the PTCs are equipped with explosive shear-plane joints located exactly below the ends of the warp core. Thus, the entire M/ARA-PTC system in that section can be jettisoned at one time.

The system does have one slight change from its *Galaxy* class counterpart. Instead of three EPS taps, this system is equipped with four. Three of the taps are in their standard locations, at 5, 10, and 20 meters from the end of the reaction chamber. However, the fourth tap is located on each conduit at the "elbow" portion of the wing (where the wing turns at a downward angle as it approaches the nacelle). This fourth tap is connected to the disruptor cannon located at that point on the wing. Since the disruptor requires energized plasma, the design engineers determined that this would be



Above: A simplified schematic of the propulsion units and EPS feeds. Note the M/ARA and antimatter pods. In an emergency, the M/ARA would be blown out the bottom of the ship and the pods would be blown out the back.

the easiest location to draw it off, and therefore placed the cannons at that point. Continued computer models and eventual live-fire IWS testing showed that there was no detrimental effect to the weapons' firing arcs or effectiveness by having them placed in that position, so the design was kept.

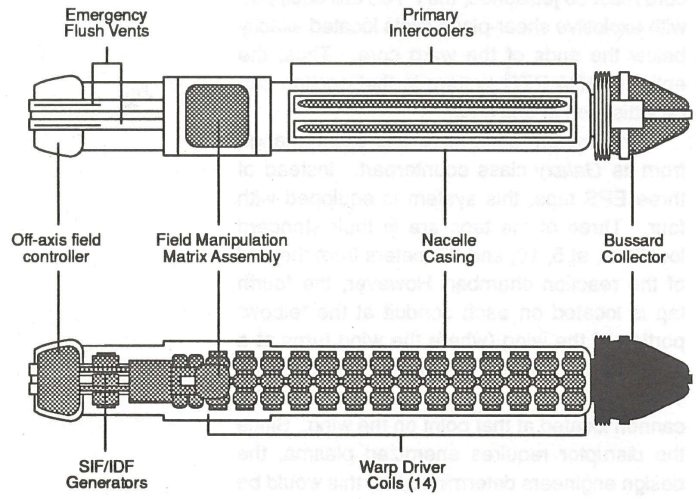
Warp Field Nacelles

The nacelles on the *Khai Tam* are almost identical in form—if not in scale—to the nacelles on the *Vor'cha*. The *Khai Tam's* nacelles are proportionately larger in every respect (including their interior components). The *Khai Tam's* nacelles are also slightly thicker to allow for the inclusion of the triple-redundancy SIF and IDF systems to help hold the nacelles together during maneuvers.

The aforementioned Klingon driver coils in each nacelle are squarer and narrower than their Federation counterparts. They are also thicker and more durable. Their operation is, in theory, similar to Federation coils, although their plasma injectors fire sequentially fore to aft rather than the aft to fore firing of a typical Federation design. This causes the warp field to emanate from the nacelle at about 3/4 of the way back from the bussard collector through a field manipulation matrix assembly unique to Klingon engines. This matrix varies the geometry of the field in a way unlike Federation engines. It works as a unit with the driver coils which are unstable and useless without it.

On *Khai Tam* (and later *Relentless*) the original Klingon nacelle design was altered slightly to allow a standard Federation maintenance port to be installed instead of the Klingon equivalent. This allows the nacelle to be serviced by a standard Federation work pod while at a starbase or during low sublight travel. For other maintenance, the nacelle is only accessible by Jeffries tubes and service crawlways in the wings. The nacelles are equipped with an emergency separation system, allowing them to be fired away from the ship at a rate of 25 meters/second in the event of catastrophic failure or combat damage.

Below: External and internal views of one of the *Khai Tam's* nacelles. Note the Field Manipulation Matrix Assembly—it has no Federation equivalent.



Impulse Propulsion

As on most any modern starship, primary sublight propulsion and auxiliary power generation is provided by the impulse propulsion system (IPS). A high flank speed capability was sought in the *Qapla'* class IPS, so early on it was decided that a Klingon design would be pursued.

Starfleet's vessels are more adapted to long-range exploratory missions, so efficiency is the name of the game in IPS design in the Federation. The Klingons, however, have much more experience in planetary system, high-speed combat maneuvers, so power is the order of the day in their IPS design. What Klingon IPSs lack in finesse, they more than make up in brute strength.

It was this unbridled pushing power that was sought in the design of the *Qapla'* class IPS. The huge IPS assembly on the *Vor'cha*, for example, would be a more than adequate replacement for all three IPS engines on the *Galaxy* even though the *Vor'cha* is the smaller vessel.

IPS Engine Configuration

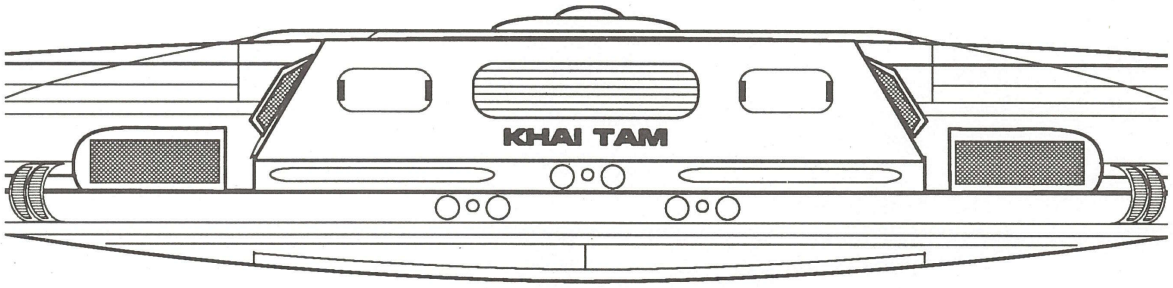
Initially, only one large engine assembly was anticipated for the primary hull, and one for the separable hull. But no one on the design team had ever had to push a ship that big that fast before, and it was soon discovered that even with Klingon engines, the plan would be inadequate. Plans were quickly revised to place two larger engine assemblies on the primary hull, with two smaller ones on the separable hull.

The primary hull assemblies are main impulse engines (MIEs) one (port) and two (starboard). Each MIE is actually an assembly integrating three large Klingon TT420 engines (the type found on the *Vor'cha*). The MIEs thrust parallel to the vessel's centerline in docked configuration. In separated flight mode, the thrust is vectored slightly in the Y+ axis to compensate for the reduced mass above the straight-thrust line.

Similarly, the auxiliary impulse engines (AIEs) in the separable hull consist of one TT420 engine each. In docked configuration their thrust is vectored slightly in the Y- axis to compensate for their position above the vessel's straight-thrust line. They are positioned to thrust straight and parallel to the centerline of the separable hull in separated flight mode. Due to their positioning on either side of shuttlebay 2, the AIEs do thrust slightly outward at angles carefully calculated to cancel each other out in directional vector.

The TT420 engine operates along the same theory as the *Galaxy's* IPS, but on a larger scale. It, too, is composed of four stages, beginning with pellet-deuterium impulse reaction chambers (IRCs), going through accelerator/generators (A/Gs), driver coil assemblies (DCAs), and ending with vectored exhaust directors (VEDs).

The principal advantages of the Klingon engines lay in the IRCs and DCAs. The IRCs of a TT420 are larger than any IRC used in the Federation. They also use larger deuterium fuel pellets and have more powerful initiators than Federation IRCs. These factors combine to produce a more powerful initial reaction per unit mass.



Below: The IPS engine assemblies as seen from astern of the ship. The smaller AIEs (angled gray blocks in center) must be carefully vectored to avoid imparting unwanted directional thrust to the spacecraft.

The DCA used by the Klingons produces a much more stable field effect than the Federation equivalent. The concept of using DCAs to assist the impulse engines (by reducing the apparent mass of the spacecraft and assisting in the slippage of the continuum past the spacecraft) is relatively new in the Federation. The Klingons have had DCAs for almost twice as long as the Federation, and their vast warp driver coil experience has led to the powerful second generation DCAs used in the TT420.

IPS Engine Control

The one area lacking in Klingon IPS design was engine control. The throttle control over engine output has always been crude, leading to inexact speeds and a characteristic lag between throttling and speed change. Similar crudity has been hallmark in the VEDs as well, requiring over compensation in course adjustments. IRC reaction rates have also been difficult to control which leads to deplorable engine efficiencies.

The joint-design team decided to attack this problem by setting Federation engineers (the "efficiency experts") to the task of rewriting the Klingon engine controller subroutines. This led to a series of headaches, arguments, and notably one fist-fight, but in the end, produced four million lines of code that solved many of the fine control problems. Fuel efficiency for the IRCs, however, remains poor.

Low Velocity Maneuvering

Initially, the design team looked at several thruster designs to provide low-sublight maneuvering capability to the *Qapla'* class. The team finally settled on a Federation package that would utilize existing impulse engine VEDs to distribute maneuvering thrust.

Then one of the Klingon engineers asked a question that had never occurred to anyone else on the team: Why not simply turn off the DCAs and A/Gs and use the impulse engines? Without the benefit of the accelerators and driver coils, IPS thrust is significantly reduced and is barely capable of pushing the spacecraft—perfect for extremely low velocity maneuvering!

Although it sounded simple, there were reasons this had never occurred to anyone. Engine efficiencies in this mode were even more atrocious than normal, and energy expenditure seemed unreasonable for the net effect. However, another concerted effort by the IPS software team resulted in a low-thrust subroutine that evened out the energy expenditure and made the idea workable.

In the end, it was decided that the slightly higher cost in energy was balanced out by the savings of not having to install thrusters. This was feasible especially because the *Khai Tam* and her sister ships are designed for maximum patrols of only one year. If she was required to perform a five-year mission, the extra fuel needed would prohibit the idea.

6 Weapons

Due to the nature of the mission they were expected to fill, the *Qapla'* class vessels were developed with some of the most complex and varied weapon systems of any starship in existence. It was due to this complexity that the design team decided to develop phasers, disruptors, and photon torpedoes together as an Integrated Weapon System (IWS). Later, deflector shields were also included under the IWS umbrella.

Treatment of all weapon systems as a unit meant that designers took into account how every aspect of every weapon interrelated to all the others. Not only has this led to remarkable efficiency in weapons operations, but the idea has spawned ground-breaking strategies in weapon deployment.

Torpedoes

Because much of the perceived threat the *Qapla'* class was built to counter involved battle at warp speeds, torpedo development was considered a high priority. In fact, the *Khai Tam* currently carries a greater number and variety of torpedoes than any ship in Federation or Klingon history.

The *Khai Tam* is fitted with six forward torpedo tubes and six aft tubes, including two aft tubes in the separable hull. She was to carry eight tubes forward, but the two outermost tubes were converted to dedicated probe launchers when her mission objectives became more exploratory in nature. The tubes are arranged in pairs and are designed specifically for the *Qapla'* class ships to handle either Klingon or Federation torpedoes. The loading systems, similarly, can load either Klingon or Federation torpedoes with warheads and fuel.

Both Federation and Klingon torpedoes are used because of the strengths of each. Klingon torpedoes are smaller and have a shorter range than Federation designs, but they are faster and have a 20% higher yield per unit warhead mass than the highest-yield Federation torpedo. On the other hand, Federation torpedoes have longer ranges and more sophisticated guidance systems than their Klingon counterparts.

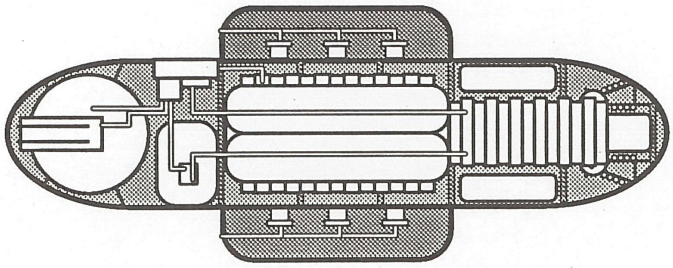
Klingon Torpedoes

Four types of Klingon torpedoes are carried aboard *Khai Tam*. Type 1 is the standard bird-of-prey round with a fixed yield. Type 1 torpedoes are small, so as many as 10 can be loaded in a single launcher at one time, and warheads and fuel are already inserted in the torpedoes, so they require no pre-flight loading. They are used primarily for quick reaction, short range firing—known in torpedo parlance as "snapshot" firing.

Type 2 torpedoes are slightly larger and have variable yields depending on pre-flight warhead loading. Both types 1 and 2 are guided by pre-flight data updated until the moment of

Mark IVq Photon Torpedo

Sensor & Guidance Section | **Warhead Section** | **Propulsion Section**



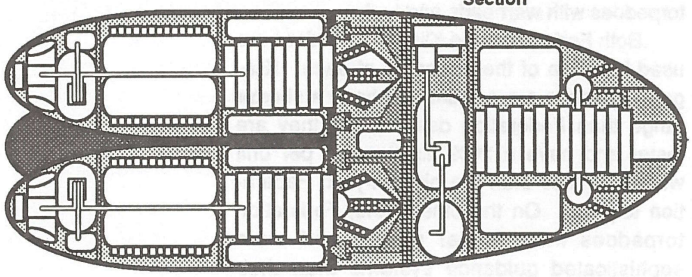
Shield generator
Sensor suite
Guidance computer
Signal Processor
Main CPU
Programmable fuse

Warhead
Isolation chambers
Field generator
Field manipulation CPU
Sabot
Sabot attachments

Multimode sustainer engine
Fuel cells
Vectored thrust nozzles
MSE control CPU

Mark V Photon Torpedo

MITS Sensor & Guidance Section | **MITS Warhead Section** | **MITS Propulsion Section** | **Warhead Bus** | **Delivery Vehicle Guidance & Propulsion Section**



Shield generator
Sensor suite
Guidance computer
Signal Processor
Main CPU
Fuse

Warhead Isolation chambers
Field generator
Field Manip. CPU

MS engine
Fuel Cell
Vectored thrust nozzles
MSE CPU

Explosive bolt latches
Blast deflectors
Separation sequencer

Guidance CPU
Main CPU
Navigational Sensor
Multimode sustainer engine
Fuel cells
Vectored thrust nozzles
MSE control CPU

Above: The two types of Federation torpedoes carried aboard *Khai Tam*. At top is the venerable Mark IV, with the added sabot that makes it into a Mark IVq. The newly developed Mark V is at the bottom (note the MITS).

launch. After launch, they are essentially unguided, proceeding along their programmed course. They can be fused to explode on impact or within a certain proximity to target.

Type 3 torpedoes were the state-of-the-art in Klingon weaponry until development of Type 4 for the *Qapla'* project. Both types have variable warhead yield, and are capable of passive or active autonomous guidance to their target. The Type 4 can actually be fired with no target information, acquire its target passively or actively, attack, and reacquire and attack if it misses or loses its target before detonation. Both Type 3 and 4 torpedoes can be fitted with impact, proximity, timed, or impact-delayed fuses. The impact-delayed fuse is used so the torpedo can drive the warhead several meters into a target before detonation.

Federation Torpedoes

Two types of Federation torpedoes are used. The Federation long ago abandoned non-guided torpedoes like the Klingon Type 1 and 2, so both the Mark IV and new Mark V have guidance capabilities equivalent to the Type 4 although their performance is superior in accuracy and acquisition.

The Mark IV has been the Federation standard in torpedo design for roughly eighty years, the only major changes in the design being software upgrades. It is basically the same torpedo carried by all torpedo-armed Starfleet vessels, although the *Qapla'* class Mark IVs (designated Mark IVq) have all been fitted with a waist ring or "sabot" so the elliptical cross-section projectiles can be more effectively launched from the new round cross-sectioned tubes. The Mark IVq has impact, proximity, timed, or impact-delayed fusing capability.

The Mark V was designed specifically for the *Qapla'* project. It is cylindrical to fit the new launcher, and therefore is able to carry more fuel to extend its range. Its most remarkable feature, however is its multiple payload design.

Each Mark V carries four multiple independently targetable submunitions (MITS) which separate from the main torpedo casing anywhere from 10 to 60 kilometers from the target. Each MITS guides itself to the target after a random break-away maneuver that presents the target with four randomly vectored incoming weapons rather than one. Each MITS has a variable yield, but their maximum yield is equivalent to 75% of a Type 1. Each can also be fused independently with any Mark IV fuse.

To add insult to injury, the delivery vehicle/warhead bus section follows the MITS into the target as well. While its effectiveness as a projectile is limited without a warhead, its momentum and residual fuel supply can land a significant punch if the MITS have been successful in destroying the target's shields.

Mines

Although mines have limited use in modern combat due to sophisticated detection and deflector systems, the *Khai Tam* does carry two types which can be laid or launched from any torpedo tube.

The first type of mine is the standard Klingon gravitic mine which is laid in position and waits dormant. When its gravitometer detects the gravimetric field disturbance of a ship, it powers up and propels itself to the target much like a slow torpedo. It can be programmed to detonate on impact, within proximity, or it can be programmed to attach itself to the target ship's hull and detonate later. It uses a similar, but smaller warhead as the Type 1 torpedo and has a very short range.

Gravitic mines are of little value against large, sophisticated targets, but can be useful for enemy detection and delay if laid in strategic choke-points. They are small, have only passive sensors, and use "quiet" propulsion systems which make them very hard to detect.

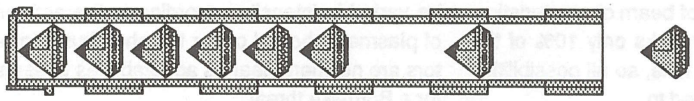
The more nefarious type of mine carried was actually developed jointly by the Klingons and Federation for the *Qapla'* class. Its official designation is the Energy Attractant Static Explosive-1 (EASE1), but it has come to be known affectionately as the "exploding leech".

Actually a hybrid of torpedo and mine, it waits in position until its passive sensors detect a target. It then activates and flies to its target like a Mark IV or Type 4 torpedo. If it encounters a deflector shield prior to reaching the target, it shuts down propulsion and "attaches" itself to the shield. It waits until the shield is lowered and then detonates with a variable yield maximizing at about Type 3 maximum yield. If the EASE1 is not destroyed before attaching to the shields, a target has a difficult situation in attempting removal as shields must be lowered to use transporters or launch auxiliary craft.

Since both types of mines are designed to start from a dormant position independent of the ship, they cannot use the traditional warp "hand-off" field from the ship and therefore cannot be used at warp speeds.

Below: A synopsis of the gravitic mine laying system. These mines can be surprisingly effective when used appropriately. Since they are so hard to detect, an area of space can be closed to traffic simply by suggesting that mines have been laid there. It will take days or weeks to confirm or deny their presence.

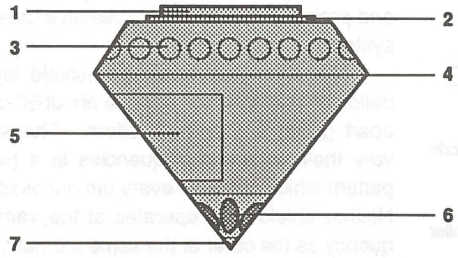
Klingon Gravitic Mine Laying System



1. Ten mines are loaded in a standard torpedo tube. The mines receive deployment instructions via tube datalink up until release.

2. The torpedo tube magnetic coils draw the mine out of the tube. This saves fuel for the mine as well as leaving the tube clean of propellant residue.

3. Once clear of the ship, the mine's propulsion system uses tiny bursts to place the mine in the proper deployment area.



Type 17 Gravitic Mine

The gravitic mine is compact and simple in design. It is easy to maintain and highly reliable. It is named for its ability to sense the gravimetric field of a ship with its sensitive gravitometer (3) and to propel itself toward that field with its whisper-jet distributed thrust propulsion system (6). Its programmable fuse (2) can be set to detonate on impact, within proximity of the ship, or within minutes of attaching iteself to the ship's hull with its magnatomic grappler (1). It uses a small but powerful shaped-charge warhead (5) to pierce the ship's hull. It receives deployment instructions via tube datalink through its circular launching collar (4) and proceeds to the deployment area where it then halts with its thrust reverser (7) and holds position until used or swept.

Phasers

Phaser hardware for the *Qapla'* class is essentially the same as the Type X phasers used in the *Galaxy* class. The same type of collimating emitter is used, and similar maximum outputs are experienced. Emitters are located on the ventral and dorsal surface of the primary hull, with smaller emitters on the aft ventral surface of the separable hull and the outboard edges of the nacelle hardpoints on the wing tips.

The advancement in the *Khai Tam's* phasers lie in the targeting and beam control software. Based on data collected in Borg encounters, the *Khai Tam's* phasers were designed to operate normally in a randomly changing manner. Beam intensity, width, and frequency can be set to vary randomly, as can the actual targeting point being fired on. The beam can be fired in a steady constantly changing stream, or a series of pulses with each pulse having different characteristics and targets.

The phaser system also has a "smart" component which analyzes attack information and damage assessments from the fire control computer. If a particular combination of frequency/width/intensity has been adapted to and shielded against, the computer deletes that combination from the random pattern so that the phasers do not waste energy and time by using combinations already adapted to. Of the millions of possible combinations of beam characteristics, the computer randomly picks only 10% of the possibilities to use at a time, so all possibilities cannot be quickly adapted to.

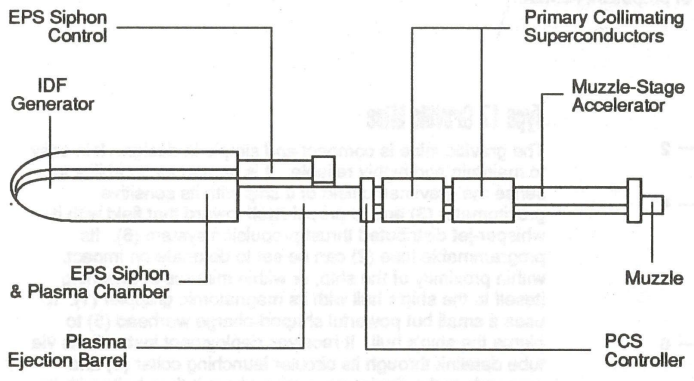
Disruptors

The *Khai Tam* carries two large Klingon GLG-20 disruptor cannons, one under each wing. She was also to have one in the forward structural ring and one on the ventral side of the separable hull, but these were deleted in favor of more science equipment when mission parameters changed.

Klingon disruptors are similar to Federation phasers in that they are beam-type weapons. There, however, the similarity ends. While a phaser draws energy from the ship's electro plasma system (EPS) to power its emitter which then emits an energy beam, a disruptor actually draws off energetic plasma from the EPS and fires plasma bursts from its "barrel". While phasers subtly but suddenly vibrate molecules apart, the disruptor goes with the brute-force approach of merely smashing them into their constituent particles. More a cross between a projectile weapon and an energy weapon, disruptors have unique characteristics that make them more desirable than phasers in certain situations, and less in others.

They are more effective at close range than phasers. Their impact on a target over a short distance is much more damaging than a phaser hit of similar intensity. However, the plasma bursts do have a tendency to dissipate over long distances, so they do not have the effective range of a phaser. The plasma bursts can be varied in intensity according to the amount of plasma siphoned off for the shot, but disruptors are nowhere near as adaptable as phasers for a Borg-like threat.

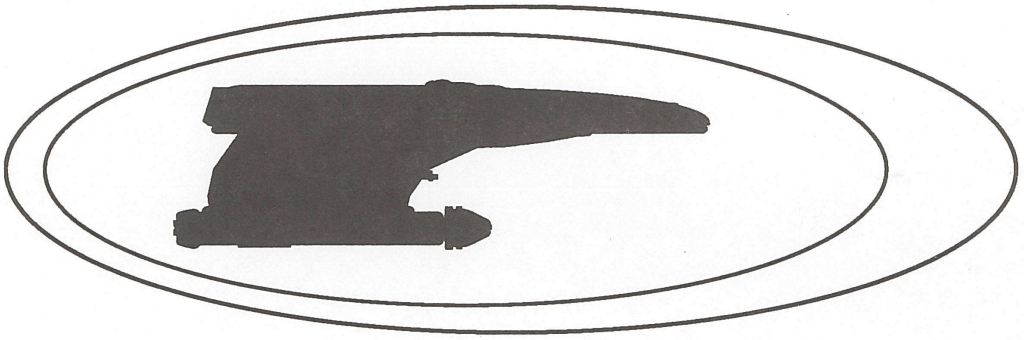
Below: Schematic of the GLG-20 disruptor cannon. Two are carried under the wing assemblies. Its smaller sibling, the GLG-17 won galactic acclaim as the disruptor of choice on the Klingon bird-of-prey design.



Deflector Shields

Deflector shields are the last-ditch defensive system of a ship. While they can be extended or contracted slightly from their normal operating range around the ship, they are essentially passive, absorbing impacts of energy and projectiles. They are a *re*active defensive system.

The *Khai Tam* has a two-shield layer of deflector shields which operate about 50 meters apart giving a "twin-hull" effect. The shields vary their operating frequencies in a random pattern which changes every ten nanoseconds. Neither shield ever operates at the same frequency as the other at the same moment.



Above: Cross-sectional shield geometry in normal "heavy front" configuration. The shield geometry of both the inner and outer layers can be altered significantly in all three axes. Both layers can also be expanded or contracted about the ship; however, the layers cannot be placed too close to one another or there will be significant interference between them.

The two-level effect is generated through a complex calculation regarding shield regeneration. Like any energy shield, the deflector shields must be regenerated every few nanoseconds to maintain their intensity. That means that the shields are significantly weakened for the critical few nanoseconds needed for regeneration. While not really "down" in the traditional sense, the shields can be exploited during this stage. Although intimate knowledge of the shield's regeneration pattern is required, this down period has been exploited in the past to insinuate a transporter beam through a ship's shields.

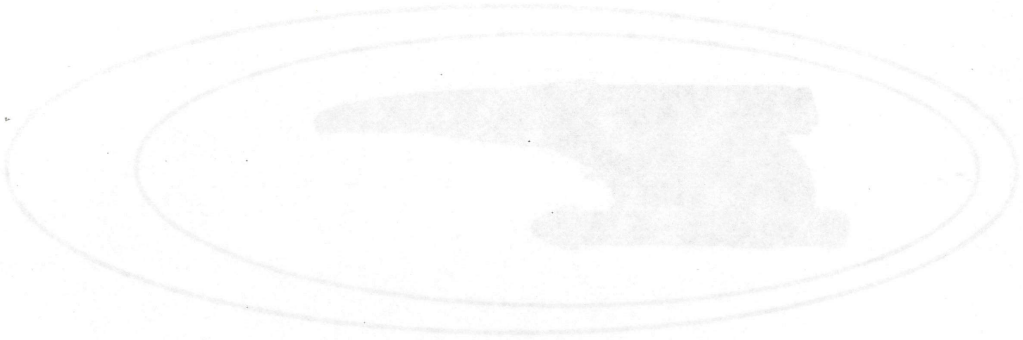
On the *Khai Tam* this "window" in the interior shield is used to regenerate the exterior shield. Although the exact timing and rate of regeneration is obviously classified, the pattern operates like this:

1. Command to raise shields initiated.
2. Exterior shield comes on.
3. Interior shield comes on.
4. Exterior shield "down" for X nanoseconds.
5. Interior shield "down" for X nanoseconds/exterior shield simultaneously regenerates.
6. Interior shield regenerates.
7. Repeat steps 4 through 6.

By carefully calculating this sequence, neither of the two shields is ever weakened at the same time (save for about ten picoseconds at the beginning of step 5). If the shields are under attack by a steady energy beam during this sequence, some energy can seep through during the regeneration process. This seepage may prevent the complete regeneration of the shield and therefore leads to a corresponding drop in shield intensity. For example, a steady beam from a Type X phaser on the *Khai Tam's* shields would lead to a 50% drop in shield intensity after about five seconds. Fortunately, a steady phaser beam of five seconds would be an enormous energy drain on the attacker.

As with *Galaxy* and *Vor'cha* class vessels, normal cruise mode calls for only minimal operation of shielding, and much of the time only one shield is used. However, the two shield variable-frequency configuration has proved hard to defeat in combat simulations.

Also incorporated into the deflectors is the new metaphasic shielding technology. The metaphasic shield generates a radiation and heat protective shield that actually feeds off absorbed EM radiation to increase its strength. It is highly useful in the close study of stellar phenomenon (its original application), but is also invaluable in using a stellar corona to hide the vessel in a combat situation.



7
IWS Operations

In the technical orientation manuals of most other ships, weapons operation is barely touched upon. Usually the normal types, and quantities of weapons are given and not much else. On those ships, weapons are not a priority and weapons handling is left to the weapons specialists.

On the *Khai Tam* however, priorities are different. Every crew member aboard is expected to know how to load, arm, and fire a photon torpedo. In a combat emergency, that knowledge may be critical. This chapter touches on the basics of Integrated Weapons System (IWS) operation. In addition, each crew member receives detailed weapons training within their first three weeks aboard.

Torpedo Operations

The most complex weapons operations aboard the *Khai Tam* are without doubt the photon torpedoes. Unlike a *Galaxy* class ship which has only one torpedo type and two main launchers, the *Khai Tam* has 12 torpedo tubes, six types of torpedoes, and two types of mines. This ordnance load and deployment scheme mean that torpedo operations on a *Qapla'* class ship are much different than on a *Galaxy* class.

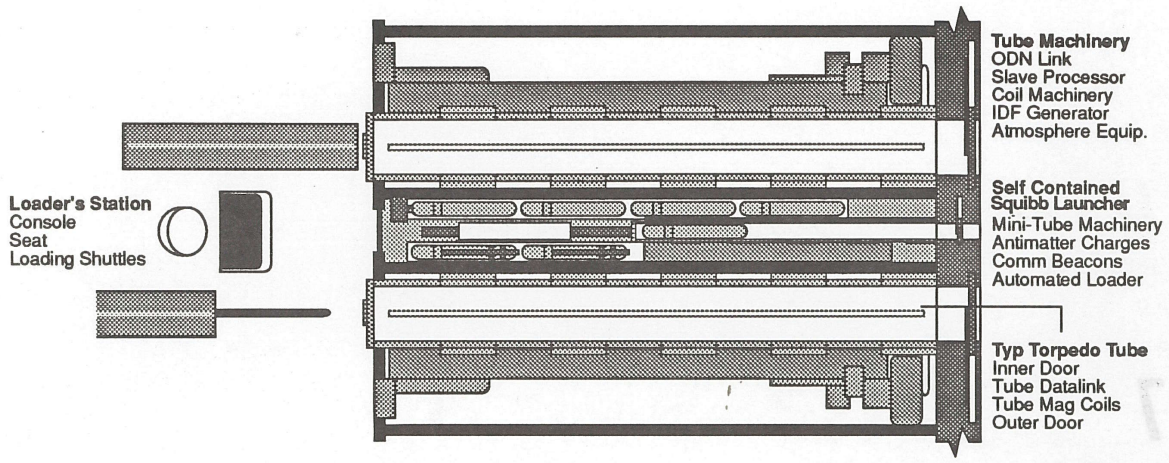
For example, on the *Galaxy*, only the Mark IV is carried, so a simple sequential loader can put round after round into the tube. On the *Khai Tam* six types of torpedoes are used so a different multi-function loader must be used.

On the *Galaxy,* the only way to increase salvo capability with two tubes is to fire more torpedoes per launch per tube—meaning very long tubes (30 meters) to hold up to 10 torpedoes at a time. On the *Khai Tam* there are 12 tubes available, so more than one round of any type of torpedo (save the Type 1) is rarely needed and much shorter tubes are used (about 10 meters).

The 12 torpedo tubes are arranged along with their loaders and ordnance storage to form torpedo bays. The Main Torpedo Bay (MTB) encompasses all six forward tubes (tubes 1 through 6). In the aft portion of the structural ring are torpedo bays two (TB2) and four (TB4). TB2 is on the starboard side and consists of tubes 7 and 8. TB4 is on the port side and covers tubes 11 and 12. On the aft centerline is the separable hull torpedo bay (TB3) which houses tubes 9 and 10.

Main Torpedo Bay

The MTB houses the torpedo fire control complex. In an emergency, the MTB can operate any other torpedo bay remotely, and all ordnance loading and firing instructions come either from here, the CIC, or the Main Bridge. Tubes 1 and 2 (tubes are numbered clockwise from the forward tube furthest to port) are rigged for Type 1 use only, while tubes 3 through 6 can be loaded with any type of Klingon or Federation torpedoes.



Above: All the *Khai Tam's* torpedo tubes are arranged in pairs, as in the installation shown here. Note the squibb launcher in between each pair of tubes. This is a sealed unit with eight small antimatter charges and four communications beacons. The squibb launchers are usually exchanged as whole units from the outside of the hull at a starbase, although there is a maintenance hatch on the interior wall for emergency access.

Torpedo Bays 2 and 4

The aft port torpedo bay (TB4) and the aft starboard torpedo bay (TB2) have rack and launcher systems identical to those in the MTB. The only difference is the ordnance load carried. In place of Type 2 torpedoes, 50 gravitic mines are racked behind each tube. And in place of Type 3 and Mark V torpedoes, two racks of 10 EASE1 mines are stowed. (See "Mine Operations" below.)

Torpedo Bay 3

TB3 is a unique case as it houses only Type 1 short-range fixed-yield torpedoes. (TB3 is basically a defense-only affair, which is why it is located in the separable hull.) These are snapshot weapons, so at least one tube is kept loaded and armed at all times. A simple sequential loader takes rounds from a conveyor/rack system directly behind each tube which houses about 20 torpedoes.

Torpedo Loading

The Type 1-Only tubes (1, 2, 9 and 10) have simple sequential loaders that are smaller versions of those found on *Galaxy* class ships. Each loader holds 20 Type 1 torpedoes. These sequential loaders have the advantage of being extremely fast and very reliable, hence their use with the snapshot Type 1s.

The remaining tubes have more complex multifunction loaders with multiple storage racks behind them. The rack system is five levels high (rack 3 is at deck level, racks 1 & 2 extend below the tube deck, racks 4 & 5 extend above). Each level holds one type of torpedo. The Type 2 rack is 20 torpedoes deep, the Type 3 and Mark IVq racks are 15 torpedoes deep, and the Type 4 and Mark V racks are 10 torpedoes deep.

The torpedoes are transferred to the tube by a multi-function loader capable of arming and fueling any type of torpedo or mine. It can also remove fuel and warhead from any ordnance withdrawn from the tube. Within 30 seconds, any type torpedo can be chambered into the tube and prepped to fire. In one minute, a round can be removed from the cylinder, re-racked, and a new round chambered to produce any ordnance load desired.

Targeting Data

The torpedoes receive target data through a series of datalinks in the system. Each torpedo is fitted with a circular launching collar. As long as this collar is in contact with a datalink strip, the torpedo is in communication with the IWS computer.

The first datalink in the loading system is at the head of each rack. The next torpedo to be used in each rack is in constant contact with the IWS computer, being fed a steady diet of

target information including all potential threats. When the torpedo is transferred to the loading shuttle on its way to the tube, it picks up the shuttle datalink which may give it more specific targeting information. When the round is chambered, the torpedo picks up the tube datalink. Here, it will confirm its previous instructions or, if it has not yet done so, it will receive assignment to a particular target or target area.

Target data usually includes at least the location of the target/target area, the best course and speed to intercept, and the safety range. The safety range is the minimum distance the torpedo is allowed to travel before detonation (to protect the ship from detonation in close proximity), and the maximum distance it may travel without detonating (to keep an armed torpedo from missing its target and continuing on for light-years until it hits something).

Launch modes

Although programmable torpedoes can be customized for almost any circumstance, there are several pre-defined launch modes:

Snapshot - A snapshot is an emergency launch when there is no time to assemble Target Motion Analysis (TMA) or to figure a firing solution. A torpedo is simply launched down the bearing of an incoming weapon or close contact.

Bearing-Only Launch (BOL) - This launch mode requires no range information. After the snapshot, the BOL is the least desirable launch mode as it has a great risk of failure.

Range-Bearing Launch (RBL) - When both range and bearing to target are known, a torpedo may be sent on an RBL. This mode has five variations:

1) RBL-Dead is the mode when the exact firing solution has been calculated from the TMA and the exact position of the target is known. With RBL-Dead information a Type 1 or 2 torpedo is ideal since they are unguided once they leave the tube.

2) RBL-Small is the mode when the general area of the target is known, but the torpedo will have to develop or be guided through a search pattern in the area to lock on the target.

3) RBL-Large requires the torpedo to perform its end-game search in a larger area. This mode is used when the firing solution is unsure, or the range information may be faulty or rapdly changing.

4) RBL-Autonomous. The big torpedoes (Type 4, Mark IVq and V) can perform an autonomous search in an area if a target is not where it is expected to be when the torpedo arrives. They can also be launched in this mode with no target information (if they do not encounter a target after reaching their safety range or after a programmed time allotment, they will self-destruct).

5) RBL-Reacquire is the mode for big torpedoes when the ship wishes the torpedo to re-attack a target that it misses on an RBL launch.

The big torpedoes also have the Autonomous and Reaquire options for BOL, but this is seldom done (BOLs are seldom required).

Launch Mode - Torpedo Compatibility Chart

■ Ideal Application
● Nominal Application

	Type 1	Type 2	Type 3	Type 4	Mark IVq	Mark V
Snapshot	■	●	●			
BOL			●	●	●	●
RBL-Dead	●	■	●	●	●	●
RBL-Small			■	●	●	●
RBL-Large			●	■	■	■
RBL-Autonomous			●	●	■	●
RBL-Reacquire				■	●	■

Mine Operations

It is said that the most cost-effective mine laying operation is a press release—the implication being that even if you only *say* you have laid mines, the enemy must still perform an exhaustive sweeping operation to assure the safety of the disputed area. Fortunately, the *Khai Tam* is equipped to go a little bit farther than issuing statements to the press.

Mine Laying

Initial velocity is of little importance in mine operations as they are left behind in a small area to attack targets later. Therefore, the torpedo tube magnetic coils gently draw the mine out of the tube with a low initial velocity, and the mine positions itself with its propulsion system after it clears the ship. This has the added advantage of keeping the torpedo tube free of propulsion residue.

While the EASE1 mine has a propulsion system similar to a torpedo, it is interesting to note that even if you wanted to "fire" a gravitic mine you could not. The mine's small propulsion system would be incapable of controlling or stopping it if it was launched at high velocity.

Ten gravitic or five EASE1 mines can be loaded in one tube simultaneously and take only seconds for distributed laying. If the tactical situation warrants, the ship's entire complement of mines can be laid in just under ten minutes. As each mine is laid, its position is carefully recorded by both the IWS and navigational computers.

Minesweeping

The tactical advantages to mines are obvious. The drawback, however, is that eventually a ship must return to sweep the mines. Of course, any ship can be a minesweeper...once. But the *Khai Tam* is equipped to sweep mines as well as lay them. In mine sweeping operations, active sensors are used to pinpoint the mine's location, and low-level phaser bursts are used to detonate the mine at a safe distance. If recovering her own mines, the *Khai Tam* can send a triple-encrypted signal to each mine, disarming it and activating a coded transponder. The ship can then beam its mines back aboard and re-rack them for later use.

Disruptor Operations

Disruptors are much less complex to operate than the torpedo/mine system. Target data is fed to each disruptor from CIC. Although generally controlled from CIC, each disruptor can be targeted and fired by her crew independently if CIC is inoperative or releases control to the crews to "fire at will".

When disruptors are brought to full alert, energetic plasma is fed from the EPS into the disruptor EPS arteries. When on-line, the EPS siphons are opened and plasma flows to the very tip of the artery, just centimeters from the weapon's chamber. When fired, the breech at the top of the disruptor's chamber opens, drawing a preselected amount of plasma from the EPS siphon. The breech is then closed and the plasma is fired electromagnetically at high velocity (up to .9c) through the disruptor's barrel. A low-level electromagnetic charge feeds through immediately after the burst to assure that the barrel is cleaned of any plasma residue. The chamber resets and the breech is readied for another round. The entire operation takes only a few milliseconds and is entirely automated.

In a normal firing operation, the disruptor crew are basically just spectators as target lock, fire control, and firing commands are all performed in CIC or on the bridge. The crew is there simply to make sure nothing goes wrong and to fix it quickly if it does. The disruptor crew does have a targeting and fire control console to operate the disruptor if needed.

Phaser Operations

The simplest weapon system aboard to operate are the phasers. Like the disruptors, they receive target and fire control information from CIC, and can be independently controlled by individual crews if necessary. The randomization of beam width, intensity, etc. (see chapter 6), is controlled by a computer dedicated to each array but linked to the fire control computer in CIC.

To fire a shot, the phaser simply draws power from the EPS to energize its emitter to a predetermined strength and fires its beam. If a burst was all that was called for, the phaser is done at this point. If a steady beam is ordered, the phaser keeps its EPS tap open to feed constantly off its energy.

8
Utilities and Auxiliary Systems

Utilities

The *Khai Tam's* internal structure houses a complex system of conduits and Jeffries' Tubes that carry the myriad utilities distribution systems of the ship. Everything from water and organic food stock, to energetic plasma and gravitons must be distributed from their origination points to any of hundreds of end-use outlets, usually via several redundant networks.

Major Utilities Networks (MUN)

On the *Khai Tam*, the MUNs are very similar to their *Galaxy* class counterparts, with differences noted below. The utilities included in the MUN are:

Power: Two major networks (each with several redundant back-ups) handle power distribution. Most major systems rely on the EPS for power. This energetic plasma produced by the WPS, IPS, or auxiliary fusion generators is carried by a series of waveguides or conduits to the several systems aboard which take their energy directly from the EPS.

Smaller subsystems and individual specialized equipment usually operate off electricity. This is provided by power converters which transfer EPS energy to an SFRA standard voltage and current. The electricity is then distributed via redundant wiring networks to the systems that require it.

Optical Data Network (ODN): Since the *Qapla'* class computers are essentially the same as the *Galaxy's*, a standard Federation ODN connects all processors, subprocessors, slave processors, I/O devices, etc. Five redundant ODN trunks connect the computer cores in the primary hull with each other and with the minicore in the separable hull. Any of the five are capable of handling the data load of the ship in an emergency, but usually the load is equally distributed. Key systems are interconnected by three separate ODN trunks which are independent of the core trunks and of each other.

Two secure communications ODN trunks run independently of all other systems and of each other. While most ODN trunks are laid out for easy access by maintenance workers, the secure comm ODN is usually routed through neutronium conduits with crypto-lock access panels to prevent tampering.

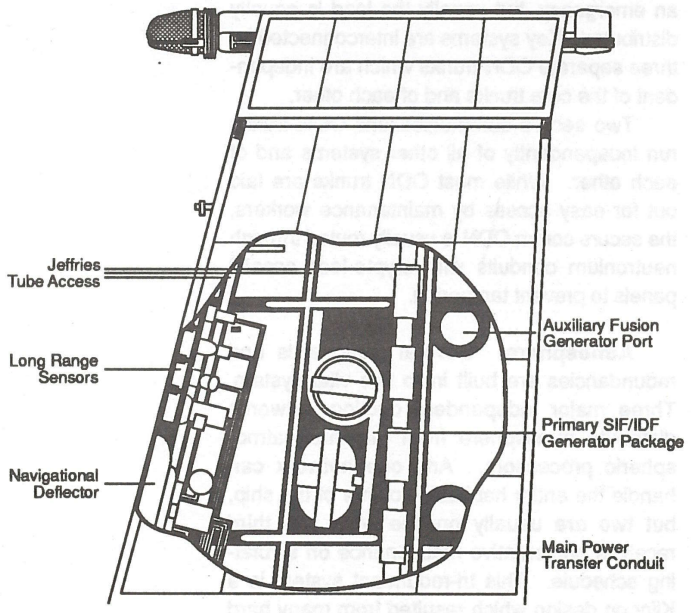
Atmosphere: Several safeguards and redundancies are built in to this vital system. Three major independent ducting networks distribute atmosphere from the three atmospheric processors. Any one network can handle the entire habitable volume of the ship, but two are usually on line while the third receives preventative maintenance on a rotating schedule. This tri-redundant system is a Klingon design which resulted from many hard lessons in combat atmosphere management.

Two separate smaller processors and duct networks provide atmospheric gasses to the areas of the ship that are converted to class H, K, and L atmospheres. Class N or N(2) environments are handled by a small redundant system that infuses gasses in the proper liquid medium and distributes them through two independent piping networks.

Water: Potable water is distributed through a system of two unconnected gravity-independent pipe/pump (P/P) systems. This water is stowed in baffled, collapsible tanks placed between the members of the structural ring assembly around the outside of the primary hull. Running parallel to the P/P systems are the return wastewater conduits which carry liquid waste to the processors (see chapter 13).

Waste Disposal: Solid wastes are transported to recovery systems (see chapter 13) through a series of linear induction conduits. Due to the non-criticality of this system, and the bulkiness of the conduits needed, there is no redundant back-up. Should the system go down, crew members must hand-carry wastes to the processors (food waste is usually returned to organic food stock via replicators).

Below: A cutaway of the starboard wing assembly reveals the location of the primary SIF/IDF generators. The redundant generators are nearer the wing tip to avoid battle damage disabling both assemblies. Also visible are the auxiliary fusion generator ports where extra reactors can be insterted to provide additional power to the SIF/IDF generators when carrying large loads on the ordnance hardpoints. The wing's structural members have been omitted from this view for clarity.



Transporter Energy: A series of Klingon-designed high-reliability, high-energy conduits connect transporters to their associated pattern buffers and emitters. This is a complex, highly interconnected system with redundant conduits available for shunting of transporter energies at a moment's notice.

Replicator and Food Service Energy: This system interconnects raw material storage areas, replicator headends and terminals throughout the ship. The food replicator conduit system is a bi-redundant system which runs independently from the replicator conduit system. Emergency food supplies are located in various storage and emergency locker areas around the ship should the system fail or need to be powered down.

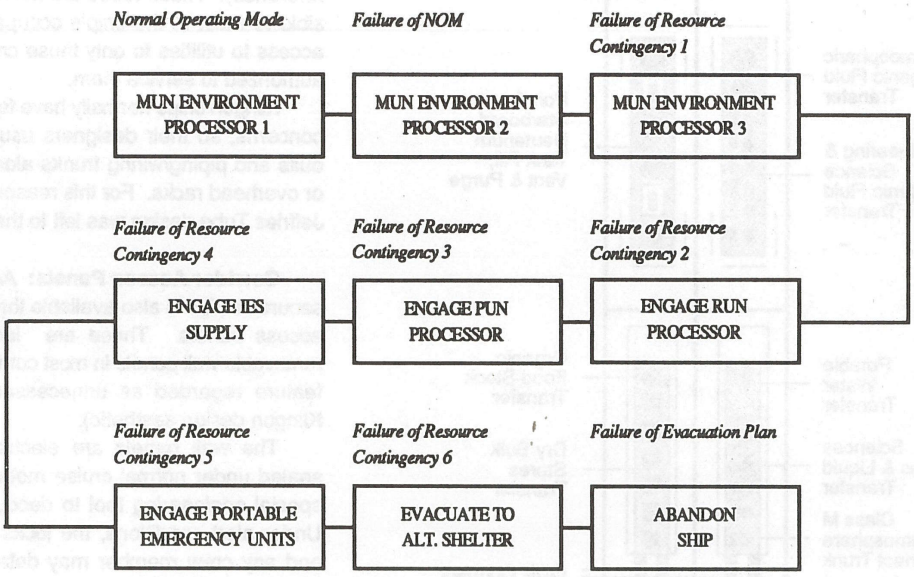
SIF/IDF Power: The *Khai Tam* has eight redundant Structural Integrity Field (SIF) systems, two in the primary hull, two in the separable hull, and two in each wing.

Any one system can handle the needs of the entire ship in an emergency, although normally the load is evenly distributed. The Inertial Dampening Field (IDF) system is similarly configured (SIF and IDF generators are usually arranged in pairs). Without these critical systems, the slightest warp acceleration would tear the ship apart, so this system is highly safeguarded and redundant in nature.

Waveguide conduits feed SIF/IDF energies to their respective conductive elements throughout the spaceframe, hull and deck plates, and bulkheads. While all the systems normally run independently, waveguide junctions allow energy from one system to be distributed through any of the other systems in nanoseconds.

When carrying ordnance packages on the under-wing hardpoints (see below), frame stress on the wing assemblies increases geometrically. To compensate, each hardpoint has an internal port to accomodate an additional auxiliary fusion generator. The generator is a standard model that can be beamed into the port and hooked up in about an hour. It provides additional power to the wing SIF/IDF generators to boost their strength while carrying the extra load.

Gravity: The ship's synthetic gravity is the result of graviton fields produced by hundreds of small generators distributed throughout the deckplates (see chapter 13).



Above: Each utility network has a catastrophic resource contingency plan (CRGP). Shown here is the CRGP for the Main Bridge's environment supply. Hopefully, plans like this will never be needed, but layer upon layer of redundancy assures the greatest protection for the crew.

These generators are interconnected, however, by a network of forcefield conduits to distribute excess inertial potential and stabilize gravity. Should a generator fail, there is usually enough excess inertial potential to compensate that area of the ship. If more than two or three generators goes down at once, a reduction in overall synthetic gravity may be experienced in various areas of the ship. Fortunately, the generators are highly reliable.

Cryogenic Fluids: A number of insulated piping systems transfer cryogenic fluids required for scientific and engineering purposes (each fluid has its own piping system). Cryogenic transfer of atmospheric components is accomplished through two redundant systems which connect the storage tanks with the atmospheric processors (although most gasses are recovered and reused by the processors, small amounts of new gasses - especially oxygen - must be added continually).

Deuterium: Fuel for the WPS, IPS and auxiliary fusion generators is stored in the form of slush deuterium in conformal tanks throughout the ship—the main tank being just above the M/ARA matter injector on deck 11. These tanks are connected to the end-use devices by two independent insulated conduit networks.

Reserve Utilities Network (RUN)

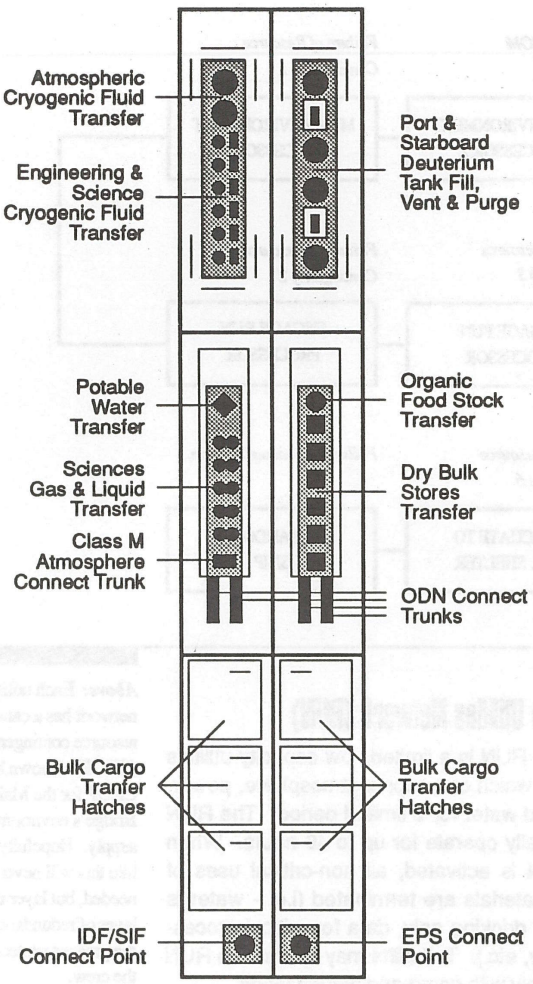
The RUN is a limited, low capacity utilities network which can supply atmosphere, power, data, and water for a limited period. The RUN can usually operate for up to 40 hours. When the RUN is activated, all non-critical uses of these materials are terminated (i.e. - water is used for drinking only, data for critical processors only, etc.). Turbolifts may operate on RUN power only with command authorization.

Protected Utilities Network (PUN)

The PUN is the last-ditch emergency backup network for atmosphere, data, power and water. The PUN is not available in all areas of the ship. It supplies only critical systems and emergency shelter areas.

Independent Emergency Systems (IES)

The Main Bridge, CIC, Sickbay Complex and certain other critical areas have independent power, data, and atmosphere systems which can operate without any utility network. These systems can be engaged at any time, although they are usually used only after failure of the PUN. The only exception to this policy is in Sickbay.



Above: A plan view of the *Khai Tam's* replenishment hardpoints with their access doors open. This assembly is located above the Main Cargo Complex on the top of the separable hull. The bow would be toward the bottom of the diagram.

The Sickbay IES is engaged immediately when the ship goes to red alert. This frees the ship's systems from having to support the Sickbay Complex and prevents interruption of Sickbay's systems if shipwide resources are temporarily interrupted or reallocated. For this reason, the Sickbay IES can operate for around 100 hours whereas most IES units can function for only 30.

Additional Utilities Systems

Jeffries Tubes: The maintenance accessways aboard the *Khai Tam* are referred to by the Federation crew as Jeffries Tubes (the Klingons, of course, have no such idiosyncratic reference). These tubes are not readily accessible to most of the ship's occupants—limiting access to utilities to only those crew members authorized to service them.

Klingon ships normally have fewer aesthetic concerns, so their designers usually run conduits and piping/wiring trunks along bulkheads or overhead racks. For this reason much of the Jeffries Tube design was left to the Federation.

Corridor Access Panels: Access to non-secure utilities is also available through corridor access panels. These are located behind removable wall panels in most corridors (another feature regarded as unnecessary under the Klingon design aesthetic).

The wall panels are electromagnetically sealed under normal cruise mode, requiring a special engineering tool to decouple the lock. Under alert conditions, the locks are disabled and any crew member may detach the panel simply by pulling up and out.

Emergency Lockers: Water and nutritional supplements (food only in the technical sense of the word) are stored in emergency lockers under the Corridor Access Panels at every major corridor intersection. The lockers also contain environment suits and medical supplies. Usually, the emergency provisions are enough for crew members to stabilize casualties and/or to get to an emergency shelter or a lifeboat or shuttlebay. A small locker of this type is also located in every stateroom.

Exterior Connect Hardpoints

In addition to the replenishment hardpoints on the top of the separable hull, the *Khai Tam* has several other exterior hardpoints which generally fall into one of three categories:

Replenishment Hardpoints

A series of six hardpoints on the top of the separable hull allow access to myriad standardized connect points for replenishment umbilicals. Such umbilicals are available at most starbases, dry docks, and on all Starfleet underway replenishment ships.

Some of the umbilical ports are used strictly for replenishment of items like organic food stock, liquid oxygen, etc.; while others can be

used to allow the docking facility's systems to take over for the ship's while the ship's systems undergo maintenance, overhaul or upgrade (i.e. - EPS, atmosphere processing, etc.).

Service Hardpoints

These are hardpoints designed for docking and service purposes. They include the three gangway/docking hatches on the forward centerline, port side and starboard side of the primary hull. Although a standard Federation gangway hatch can mate on any of the three, gangways are almost always mated to the fore hatch as few facilities have gangways long enough to reach over the wing assemblies.

Other personnel transfer connections include two large elliptical tunnel connectors at the top of the separable hull (as in the *Galaxy* and *Nebula* classes), and turbolift pass-through hatches on the top of the main bridge. The pass-throughs allow ship and starbase turbolifts to pass freely between station and vessel.

Bulk cargo is loaded primarily through the six replenishment hardpoint hatches and through the two shuttlebays. Below the replenishment hardpoints and forward of shuttlebay two is the ship's Main Cargo Complex with ten holds of varying size and configuration. Most cargo bays are located in the separable hull so that the space may be used for emergency shelter in case of hull separation.

Other cargo bays are placed around the hangar deck on Deck 17, and various smaller specialized holds which utilize cargo transporters to move goods are located on Decks 8 and 11. The large bunk rooms on Deck 11 can also be configured for small cargo.

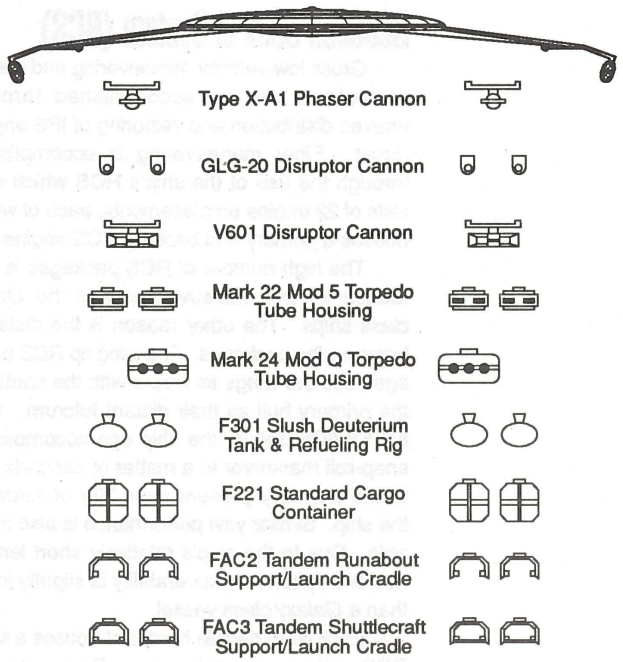
Ordnance Hardpoints

A unique feature the *Khai Tam* owes to its original combat mission is its ability to fit exterior ordnance packages on its four under-wing ordnance hardpoints. These hardpoints can fit a variety of packages (see illustration), significantly increasing the ship's defensive punch when the situation requires. Four more hardpoints were originally planned for the top of the wings, but computer simulations showed that the arrangement would significantly reduce the field of fire for the dorsal phaser array, and in the end it was felt that four hardpoints would be sufficient for most contingencies.

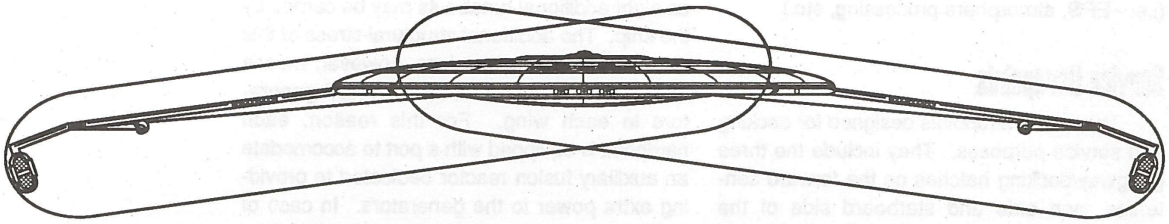
The ordnance hardpoints also have personnel and support fittings in place to service auxiliary craft. Because of this feature, as many as eight additional runabouts may be carried by the ship. The additional structural stress of this much mass under the wings, however, means more power is needed for the SIF/IDF generators in each wing. For this reason, each hardpoint is equipped with a port to accomodate an auxiliary fusion reactor dedicated to providing extra power to the generators. In case of significant partial or total wing SIF/IDF failure any underwing packages or craft are jettisoned.

Auxiliary Power

Main power for the *Khai Tam* is usually produced by the WPS or IPS. However, there is a system of auxiliary fusion generators located around the ship to provide additional power when needed or auxiliary power in case of main power failure or in case all WPS/IPS power is needed for propulsion. These generators are small copies of Federation IPS reaction chambers, and are located in strategic areas to minimize the possibility of battle damage.



Above: Some of the many options for ordnance hardpoint packages. Others are available and more are being designed. So far the most-used package has been the FAC2 Runabout cradle. These relatively new warp-capable Runabouts are finding more uses than their designers ever hoped.



Above: A bow view of *Khai Tam* with her navigational deflector target areas superimposed. The target areas overlap by design across the widest cross-section (and most inhabited) area of the ship. These target areas can be expanded or changed in shape—this picture illustrates the normal cruise mode area.

As a last resort in case of total power generation failure, key areas of the ship are equipped with large banks of sarium krellide power cells for reserve power capacity. These cells are kept at a constant state of charge via EPS connections during normal cruise mode. On alert status, the cells are isolated from the ship's other power systems. Without use, their charge will remain at nearly 100% for several days, after which a gradual degradation will occur in charge (the cells will usually be at 50% charge in five weeks). Under heavy use, the cells will last anywhere from 30 to 60 hours depending on circumstances.

Reaction Control System (RCS)

Gross low-velocity maneuvering and course corrections can be accomplished through uneven distribution and vectoring of IPS engine thrust. Finer maneuvering is accomplished through the use of the ship's RCS which consists of 22 engine emplacements, each of which houses a primary and back-up RCS engine.

The high number of RCS packages is one reason for the maneuverability of the *Qapla'* class ships. The other reason is the distance between the packages. The wing tip RCS packages use the wings as levers with the center of the primary hull as their distant fulcrum. With full SIF/IDF output, the ship can accomplish a snap-roll maneuver in a matter of seconds that would normally present over 20*g* of force on the ship. Similar yaw performance is also available. Due to the ship's relatively short length, however, pitch maneuverability is slightly lower than a *Galaxy* class vessel.

Each warp nacelle hardpoint houses a small RCS package on each corner. Each wing also has a larger package on the leading and trailing edges near the disruptor cannons. Even larger *Galaxy/Nebula* class RCS packages are used on the "corners" of the primary hull. Four of the smaller packages are used around the aft end of the separable hull, and two units are on the port and starboard sides of the forward end of the separable hull. These forward units are actually covered by the primary hull in docked configuration and are not used in normal operations (they therefore carry a limited emergency-only fuel supply).

The units themselves are Federation-standard gas-fusion/magnetohydrodynamic trap devices equipped with mooring/docking tractor beams. Klingon RCS technology is, by coincidence, almost identical in nature, so the design team saw no reason to take up time on the issue of RCS design. Since it was a *Galaxy class* spaceframe to begin with, the Federation RCS engines were the natural choice.

Navigational Deflectors

The design of the *Khai Tam* did not allow for the standard in Federation navigational deflectors: the "dish". The forward profile of the ship was simply too narrow to allow for placement of a deflector dish, so the problem fell to the Klingon engineers who have never used the dish approach in their design.

The deflector system developed by the Klingon design team is subtle and elegant. Using thin, phased-array deflectors in the leading edge of each wing, the navigational deflector profile is similar to two overlapping searchlight beams (although elliptical rather than round). Each deflector provides nominal protection to each wing and nacelle from stray micrometeors

or other particles in the ship's path. The beams overlap in front of the primary hull, however, providing an extra measure of protection to the habitable volume of the ship.

Klingon navigational deflectors consists solely of the sweeping, long-range tractor/deflector to clear the ship's path, and do not use the nested-shield concept prevalent in Federation designs. However, the phased array technique used provides for a 350% increase in sweeping frequency, making the nested-shield unnecessary. The cost is increased power to the deflector, but for this application, the benefit was well worth the price.

Another advantage to the phased-array approach is that the deflector beams can be "steered" much more precisely. This allows for better manipulation of Bussard collector fields. Rather than having to create "holes" for hydrogen atoms in a nested-shield (as most Federation ships must), the phased array deflector simply diverts the atoms to within a few decameters outboard of the collector so that they can be attracted in a hyperbolic course by the collectors' magnetic fields.

The separable hull has a similar but smaller phased-array unit in its forward end. It is covered by the primary hull in docked configuration and is not used in normal operations.

Long-Range Sensor Considerations

Due to the subspace and EM interference generated by the navigational deflector, long-range sensors must be able to "see" through the deflector field or else they are blinded by the interference. In a Federation "dish" deflector, this is accomplished by placing the sensors behind the dish on its axis. With the phased array configuration of the *Khai Tam's* deflectors, however, a much simpler approach is used.

Long-range sensors are embedded along the leading edge of each wing. The sensors are simply calibrated to be out of phase with the deflectors so that they are looking between the deflector beams. The deflector cycles in picoseconds, and the sensors cycle in the picoseconds in between. It all happens so quickly that to a humanoid observer they appear to be simultaneous and steady beams. This technique is not quite as effective as the Federation equivalent because of the residual fields left behind by the deflectors even in the picoseconds between cycles, but it is sufficient to give the *Khai Tam* roughly 80 to 90 % of the *Nebula* class long-range sensor capability.

Tractor Beams

Tractor beam technology has changed little in the past four decades both for the Federation and the Empire. In fact, there is even little difference in the tractor beams found on Klingon and Federation vessels. Since little gain was anticipated in trying to combine the technologies, no new design work on the *Qapla'* class tractor beams was undertaken. The primary tractor emitter for the *Khai Tam* is a Federation unit similar to that used on the *Ambassador*, while the smaller secondary emitters are Klingon units like those on the *Vor'cha*. The low-power unit used by the separable hull is also Klingon—identical to the highly reliable unit used on the bird-of-preys. The only technological advancement required on the tractor beam project was in mating the Klingon and Federation control systems. This was accomplished largely through software modifications.

Replicator Systems

Here, too, little original design effort was placed in the *Qapla'* project. The replicators aboard are all Federation design and are the same as those found on most major starships. The Federation replicators were chosen simply because they had a higher software adaptability and slightly lower single-bit error rates. The primary difference between the replicator systems aboard the *Khai Tam* and other Federation ships is simply the library of patterns available to choose from.

9
Communications

Communications aboard the *Khai Tam* fall into two general categories: internal or intraship, and external which includes ship-to-ship and ship-to-shore. In order to meet the varying mission requirements in both these categories, the Communications Department is divided into Internal and External Communications Groups.

Internal Communications

Intraship transmissions aboard the *Khai Tam* are handled by a Federation-designed system very similar to that of a *Galaxy* class starship. The most notable difference being simply another redundant system layer to further guard against battle damage. Wherever possible no two communications/data lines physically cross or even run close to each other in the structure of the ship for the same reason.

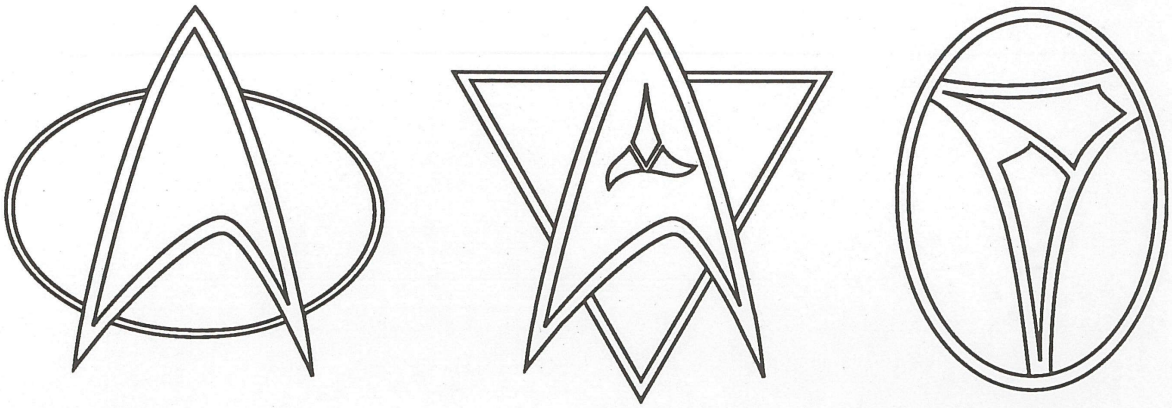
Although most intraship communications are fully automated, the *Khai Tam* does have a communications center which monitors these automated functions as well as running diagnostics, performing periodic maintenance, and setting up and operating any special communications required. Another important function of the comm center is the encryption and decryption of secure transmissions both internal and external in nature. The comm center is well protected by being in the center of the primary hull on Deck 8, just abaft the Combat Information Center (CIC) and just above the sickbay complex.

Intraship Communications

Intraship calls are usually placed in one of three ways. First, the ship-wide intercom may be accessed simply by addressing a message verbally. This is the most common way to initiate intraship communications, but it is not always effective. If several people in the area are talking at once, or the individual is far away from an intercom pick-up (say in a cargo bay), personal communicators are usually the method of choice (see below). The third most common method to initiate an intercom call is via keyboard on any of the ship's many comm panels.

To initiate a voice or data call, a crew member simply states the destination of the call by individual, department, or function name and the name , function, or department making the call. Examples: "Weapons, Conn," "Engineering from Ensign Davis," "Computer, download tricorder to main sickbay processor" or "Arboretum to Technician Fuller" (note that the computer understands the context of which party is originating and which is receiving. If no modifiers are used as in the first example, the default is: "destination, origination").

Another type of intraship communication is the public address. Using the same hardware as above, messages can be broadcast over the ship's loudspeakers in one or several areas of the ship. Similarly, a message with accompanying video can be broadcast on any number of viewscreens. An all-hands address is



Above: The three communicators issued by the *Khai Tam's* Communications Department. From left to right: the Starfleet crew communicator, the Klingon exchange crew communicator, the family/civilian communicator. In addition, any personally owned communicator capable of being tuned to the proper frequency can be encoded in the system.

broadcast throughout the ship and/or on all viewscreens. All-hands addresses must be authorized by the command staff, the Officer of the Deck (OD), or the Communications Officer. The computer can implement all-hands addresses under certain conditions, most notably when sounding red or yellow alerts or notifying the crew of some other emergency.

Personal Communicators

Every person aboard the *Khai Tam* wears or carries some type of personal communicator, normally referred to as a combadge. There are three main types of combadges aboard: Starfleet issue (the standard Starfleet uniform emblem), exchange crew issue (a unique design pin similar in size to the Starfleet issue and worn on the uniform), and family/visitor issue (a decorative jewelry piece which may be worn or carried. The internal construction of all three pieces is similar as are their operation.

When a person arrives aboard the ship for more than a couple days, they are either issued a combadge or the combadge they already have is entered into the system for recognition. This gives the person limited access to the intraship network. Further access to intraship communications, secure communications, or external communications can be arranged by the Communications Officer with the approval of Security. Any call made from a combadge that has not been entered for recognition is treated as an external communication.

Combadges play other important roles as well. Each combadge gives off its own unique low-level ID signal when queried by a properly encoded computer pulse. Through this signal individual crew members can be located anywhere on board. This signal is also used to identify people for access to certain areas that are not secure, but where common area traffic would not be acceptable (i.e.- in the working areas of sickbay, the doors will only open for the combadges of the medical or command staff). Secure areas are governed by voiceprint and/or keyboard code entry. The combadge is also used to establish quick transporter lock on the owner, although it is certainly not necessary for proper transport.

Each combadge is encoded to respond only to its owner. It cannot be used by anyone else without a priority override.

Ship-wide Media Publication

Another important function of the Internal Communications Group is the production of various media for the ship's crew. One ongoing production is the ship's electronic newsletter.

Keeping over 800 crew members up to date is a difficult task, but the weekly publication of the electronic newsletter by internal communications helps. This publication keeps the crew informed of important ship's news, upcoming events and ports of call, scheduled training and recreation programs, etc.

Once a week, the latest newsletter is downloaded to every crew member's stateroom terminal, and can be called up on any ship terminal or PADD simply by stating, "display newsletter". The newsletter staff also administrates the ship's electronic suggestion box/messaging center.

Internal Communications also produces audio/visual and holographic media for the ship's training department. Any information which must be communicated to the crew in such a manner is usually the responsibility of Communications.

Secure Communications-Internal

Another unique feature in the *Khai Tam's* communications system is in the method used to secure classified transmissions. For internal communications that are sensitive or classified, a separate hard-wired encrypted communication net is installed in the *Khai Tam* that runs independently of the basic intraship network. The dedicated crypto net is a feature of most Klingon ships, and the Klingon design team developed this net as well as the crypto hardware that encodes and decodes messages along it. Cryptography is the strong suit of Klingon communications, and the Klingon team contributed significantly in this respect.

All communications aboard ship are encrypted according to a variable supplied by the sender's communicator or intercom pick-up simply to make the transmission unique among the thousands that may be occurring at any moment. But for a secure call, extra measures are taken.

Intraship secure communications are hard-wired via optical data network (ODN) on the secure net. When a secure call is placed, the computer knows the exact distance of fiber optic cable between the caller's comm pad and receiver's comm pad (or if the call is made/received via combadge, it knows the distance from the radio frequency (RF) pick-up nearest the caller to the RF pick-up nearest the receiver), so it knows exactly how long a light pulse should take to get from one to the other, and how strong the signal should be at the far end.

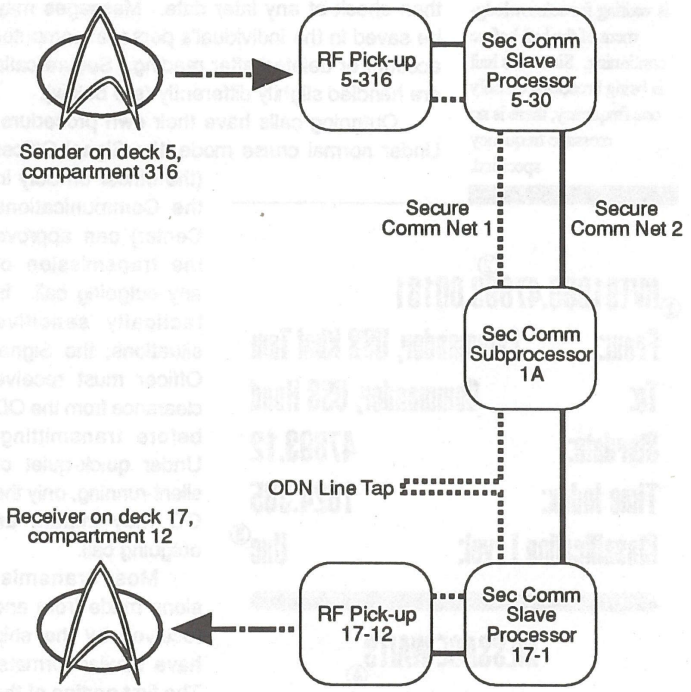
Using this information, the computer sends a confidence pulse down the line every 10 milliseconds to verify line integrity. If the line is being tapped, the pulse will either be delayed in reaching the far end or it will arrive with weakened signal strength. Should this happen, both parties, Communications, and Security are simultaneously notified of a possible line integrity breach. Once a secure link is established, not even the comm center can tap into the line without performing a priority override.

To initiate a secure transmission the caller simply asks the computer for a secure channel. The computer will then identify the voiceprint of the caller, determine what access level they are authorized for, determine the access level the intended receiver is authorized for, and establish the encrypted link.

If the computer does not recognize the caller's voice, the computer will ask for the caller's secure communications code. All crew members with access to secure communications are assigned such a code, which is only input via keyboard, never spoken (a standard feature in many Klingon crypto systems). Any attempted access by unauthorized personnel results in an alert signal sent simultaneously to Communications and Security showing the identity of the caller (if known) and the location they are attempting to gain access from.

External Communications

One of the most sensitive areas of ship operations is external communications. A broadcast signal will easily give away a ship's position and could endanger ship and crew. On the



Below: A secure internal call from combadge to combadge. The computer knows the exact distance between Pick-up 5-316 and Pick-up 17-12. A confidence pulse sent from 5-316 should take a known amount of time to get to 7-12, and it will down Net 2 (solid line). If the pulse is sent down Net 1 (dotted line), however, it will take longer to get to 17-12 and the computer will discover the line has been compromised.

other hand, communications with the "outside world" is sometimes essential, and is always desirable for personal communications (especially for those who's families are not aboard).

In any case, on the *Khai Tam* standard Federation subspace and radio frequency (RF) communications are used for normal communications. Only the procedures vary from other ships. For secure communications, however, the Klingon design team once again developed a highly secure and efficient communications system to make the *Qapla'* class ships unique.

Voice Communications

The first type of transmissions handled by External Communications are voice calls. In this category are voice-only, voice-and-visual, and voice-and-data calls. In other words, if it's a message from somebody to somebody, it is considered a voice call. Voice calls are most often handled by the comm center, although some high-priority communications are handled directly by the Main Bridge or CIC.

Any non-secure incoming call is usually routed directly to the addressee. If they are not available, the message is shunted to that individual's message buffer which they may then check at any later date. Messages may be saved in the individual's personal computer account or deleted after reading. Secure calls are handled slightly differently (see below).

Outgoing calls have their own procedure. Under normal cruise mode, the Signal Officer (the officer on duty in the Communications Center) can approve the transmission of any outgoing call. In tactically sensitive situations, the Signal Officer must receive clearance from the OD before transmitting. Under quick-quiet or silent-running, only the CO may initiate an outgoing call.

Most transmissions made from and received by the ship have similar formats. The first portion of the transmission is the "hailing packet". This is a prefix to the actual message that verifies the frequency that will be used for the transmission (in the case of a multi-frequency hail), who is sending, who the message is for, the stardate and time of transmission, and the classification level and code keys if the transmission will be secure (see below). After the hailing packet is sent/received, the actual message begins. In the case of a one-way communication, the message immediately follows. In the case of a real-time dialogue, the message is held until the prefix is read and the call is routed to the recipient.

Under tactically sensitive conditions, much one-way communication (especially *Khai Tam* to Starfleet) is accomplished through "squirt" transmissions. These are transmissions which are recorded then compressed so that they may be sent in a much shorter period of time, thus lessening the risk of revealing position. The squirt transmission is decompressed at the far end and played back normally.

Data Communications

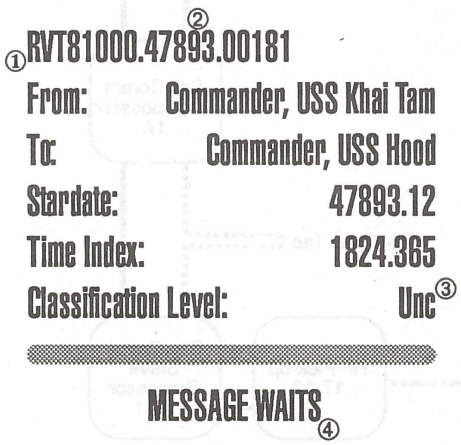
Large amounts of data to be transmitted or received are usually handled as data calls by the datalink specialists. The primary difference between voice and data calls are that data calls are usually very large; almost all data; addressed to a ship or base, not a person; and are sent or received computer to computer with little crew intervention. Examples of data calls would be library files, software upgrades, or batch news or entertainment broadcasts.

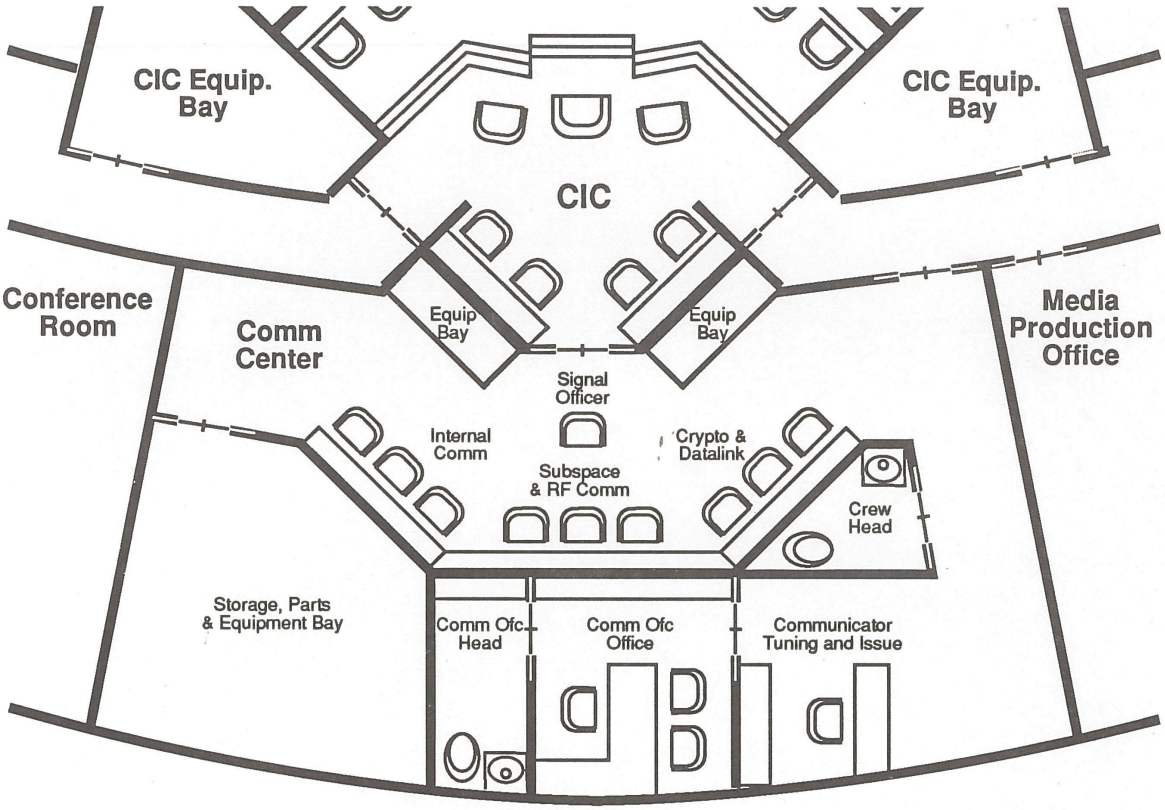
An incoming data call is identified by a DT prefix in the hailing package. The computer automatically routes the call to the datalink specialist on duty. If the transmission is to be a real-time datalink between computers, the specialist establishes the link along with the computer operators in Engineering. If it is a data package for batch download, the specialists can place the message in the comm data buffer where the Engineering Department can retrieve it at their convenience. With batch uploads, Engineering sends the data package to the comm data buffer where the specialist can retrieve and transmit the data.

Secure Communications-External

All external communications are routinely encrypted with one of several Starfleet codes

Below: An example hailing packet. Features to note: 1) The "RVT" prefix indicates this is a "real-time voice transmission"; 2) The message number format (NCC number. stardate. number message sent this stardate); 3) The "Unc" shows this message is unclassified requires no code key information; 4) The "Message Waits" banner indicates the caller is waiting for acknowledgment of the hail before continuing. Since this hail is being broadcast on only one frequency, there is no message frequency specified.





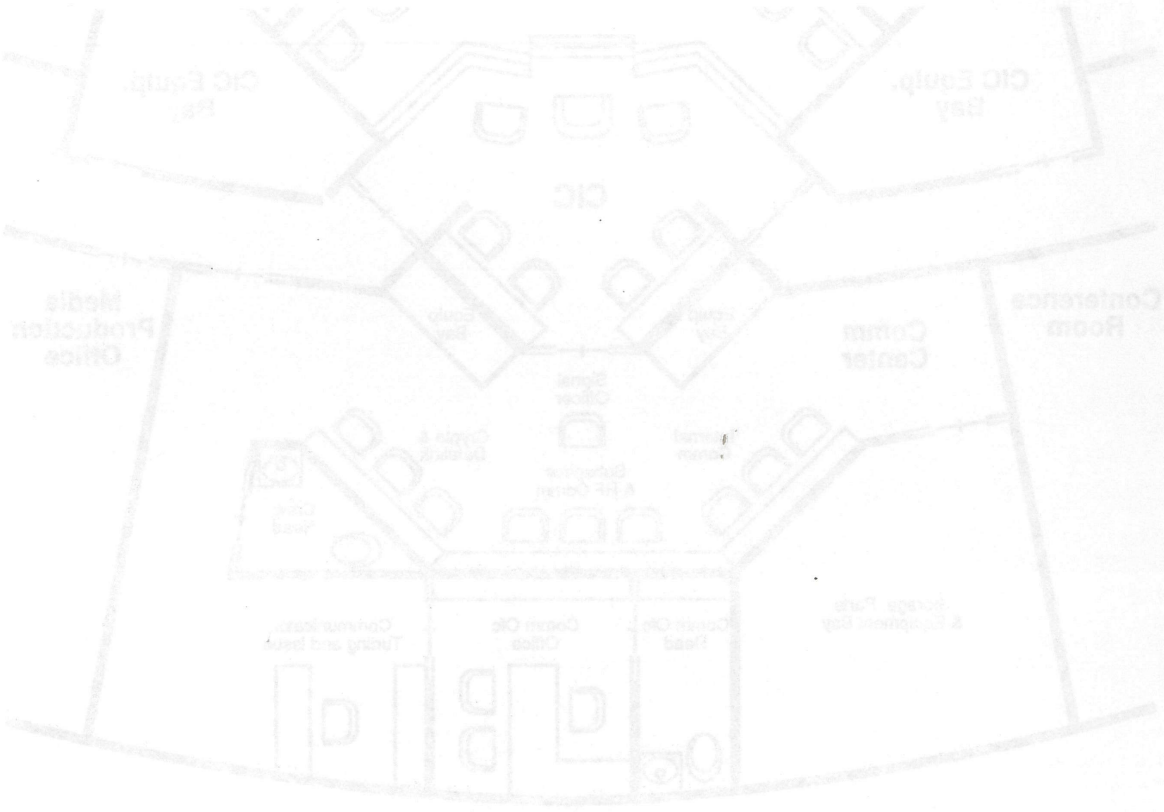
Above: A floor plan of the Comm Center shows the compact but efficient work area for the communications specialists. The Signal Officer is constantly aware of all communications activity. Much of the space is occupied by equipment bays which hold the dedicated communications subprocessors and other critical hardware.

that are periodically changed to avoid compromise. However, for classified or highly-sensitive information, another level of security is needed.

If such a transmission is going over RF or subspace, the computer secures the transmission in two ways. First, the computer will "frequency hop", changing frequencies over 500 times a second during transmission in a pseudo-random pattern called a hop set. The frequency hopping algorithm is chosen at random from a select group of code keys that is changed at least every other month. The hop set key is sent to the receiving unit in the hailing package prior to message start so that sender and receiver will frequency hop in sync.

The message is also encrypted using one of several encryption algorithms (which are changed along with the hop set keys). The algorithm for a call is chosen at random by the computer from the preselected list and the variable that completes the algorithm is chosen at random from the first 1000 prime numbers. No one knows which algorithm or crypto variable will be used ahead of time. The algorithm and crypto variable are transmitted with the hop set key in the hailing package. The receiving unit must have the same selection of hop sets and crypto variables loaded before receiving the hailing package or the computer will not initiate the message. This assures that the receiver is authorized to decode the transmission.

If the exact position of the receiving party is known, communications can be further protected by omnidirectional transmission. A tight-focus tachyon beam can be used for subspace transmission. If light-speed transmission will do, it can be made via digitized laser. The laser uses a frequency modulation pattern similar to the RF frequency hop. In either case, the transmission is protected because an enemy would have to be in the direct line-of-sight in order to intercept the transmission (as well as having the correct hop set key, encryption algorithm, and crypto variable).



10
Transporter Systems

The transporter systems aboard the *Khai Tam* are one of the most "hybridized" of her joint-technology systems. The combination of the range and refinement of the Federation transporters with the accuracy and power of the Klingon systems was not an easy one for the design team. It required overcoming many technical obstacles, but the end result was a distinctly improved transporter system.

Klingon transporter technology was developed and refined especially for transport in demanding situations (i.e. getting personnel in and out of combat situations with precision). Access to this technology provided the Federation with a baseline, and the design team developed a transporter system combining the best aspects of the two technologies. The drawback to the improved ability of these systems is the increased power drain placed on the ship. A typical transport expends, on average, 17% more power than a standard Federation transporter would use in similar circumstances.

Personnel Transporters

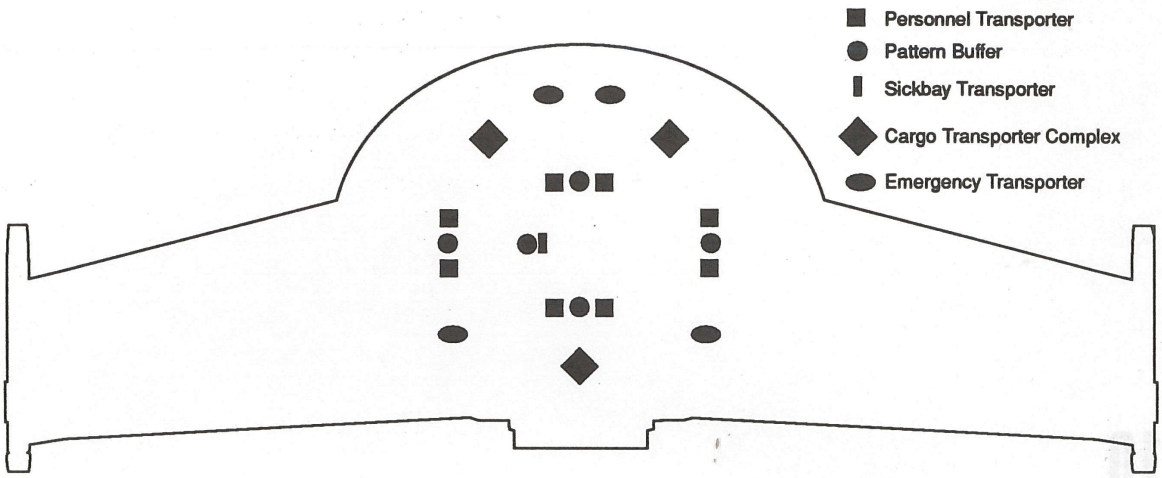
Personnel transport to and from the ship is accomplished by nine personnel transporters located throughout the vessel. Transporters 1 through 8 are paired off, sharing a pattern buffer as is done on a *Galaxy* class starship. The first pair, Transporter Rooms 1 and 2, are located on deck 3, just forward of the bridge. These are the only transporters in the separable hull, and are the ones typically used for transport to and from the ship. Transporter Rooms 3 and 4, are located on deck 7, port side. This pair is matched by Transporter Rooms 5 and 6, on deck 10, starboard side. The final pair of transporters (7 and 8) are located just forward of Main Engineering on Deck 12. Transporter 9 is a small, two person pad located in Sickbay and used primarily for medical emergency cases and site-to-site transports.

Standard operational range of these transporters is 45,000 kilometers. This is slightly farther than either a standard Federation or Imperial Klingon transporter due to the refinements created by the design team. Both fleets are considering integrating the new designs into their uprates of existing vessels and newly constructed vessels.

An interesting side note: the transporter effect, usually bluish in a Federation transporter and reddish in a Klingon transporter, is actually a dark magenta in the new joint-technology transporter. Although this seems logical (red and blue do combine to create purple), the effect has never been adequately explained.

Cargo Transporters

Mass cargo transport is accomplished by four molecular-level transporters located in the Main Cargo Complex on Deck 3, and by two molecular-level transporters located in Cargo Bay 5 on Deck 8, and Cargo Bay 9 on Deck 11.



Above: Schematic showing general locations of transporter units. This diagram has been simplified for clarity, but it can also be misleading. The units are not drawn to scale, and they are located on several different decks. Also, the pattern buffers shown are only for the personnel transporters.

These transporters can be used for life-form (quantum-level) transport, but to do so would require a severe reduction in the payload capacity of the transporter.

Escape Transporters

Escape transporters, of which there are only four on the *Qapla'* class, are designed exclusively for the evacuation of the crew during a crisis situation. These transporters are high capacity life-form transporters designed to operate at low power levels, and as such have a limited range (approx. 20,000 km). The relatively low number of escape transporters may seem unusual for a Federation ship, but it is due to a compromise between the Klingon and Federation design teams.

The Klingons felt that it was honorable to "go down with one's ship" as it were, and did not see the need to have such an energy-intensive system on board. The Federation engineers disagreed, but before the dissension went as far as physical violence, cooler heads prevailed, and four escape transporters were incorporated into the design.

An additional feature of the *Khai Tam's* escape transporters: they can easily be set to initiate the autodestruct sequence once the crew has beamed safely away. This particular development was created by Klingon engineers after careful appraisal of an apparently similar tactic used against them by a Federation captain several years ago.

Pattern Buffers

Each pair of personnel transporters share their main pattern buffer tank, located one level below the transport chambers themselves. The transport buffers for the emergency transporters are routed through these main pattern buffer tanks in emergency situations, as in the *Galaxy* class vessel, if the primary buffer tanks are operative. The medical transporter is the lone exception; it has its own dedicated buffer tank. This tank can be used by other transporters, but medical emergencies have immediate priority.

The sharing of buffer tanks allows for an increase in system efficiency of 47.9% while only reducing the payload capacity of the shared buffers by 34.4%. If the primary buffers are not operating, the emergency transporters will still operate, but at a slightly slower and less efficient rate.

Transporter Emitters

The exterior hull of the ship incorporates sixteen transporter emitters, providing the ship with omnidirectional transport capability, even if 37% of the emitters are inoperative. These emitters are slightly bulkier and larger than the standard Federation emitter due to the increased intensity of the annular confinement beam, the molecular imaging systems, and targeting scanners. These refinements are discussed further in the next section.

Transporter Components

Each of the major transporter components is listed below, along with the improvements/changes incorporated.

Transporter Chamber: Aboard the *Qapla'* class, the transporters are cramped and small compared to the standard Federation transporter room, but the Klingon engineers describe it as "quite large" for a Klingon transporter. The actual transport platform is of comparable size to a Federation transporter, but is rectangular in shape instead of circular.

Operator Console: This control position is not very far removed from its standard Federation counterpart, other than in aesthetics. The console is more angular in its displays, reflecting the Klingon influence in its design.

Transporter Controller: This system is identical to a standard Federation transporter, with only a few differences in programming to accommodate the hybrid technology.

Primary Energizing Coils: This system has been improved to incorporate some new features. First, the Annular Confinement Beam (ACB) has been increased in intensity and has frequency modulated to allow it to be used as a force field for confining incoming transportees (or unwelcome guests). As an additional effect, this has reduced the danger of ACB disruption leading to energy discharge during transport. This development, apparently long sought after by Klingon engineers, was made possible only through recent advances in field physics by Federation scientists.

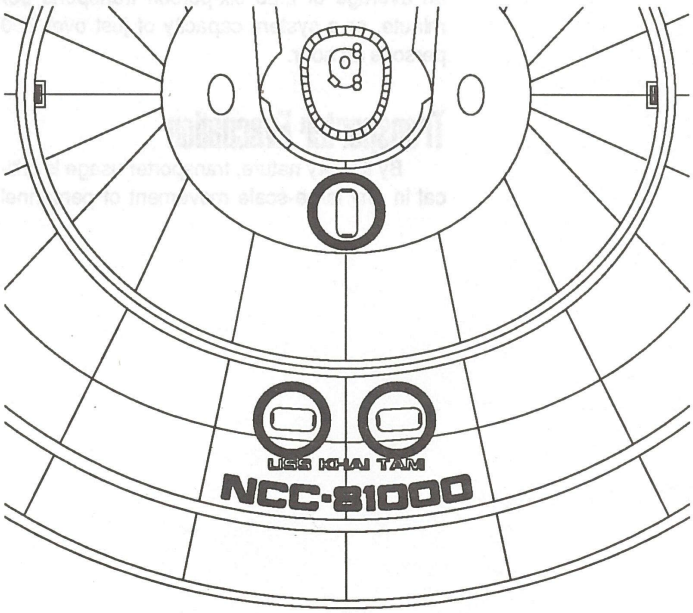
Phase Transition Coils: These units are responsible for the materialization/dematerialization process. They have not undergone major alterations, except to accommodate the intensified ACB and improved imaging scanners.

Molecular Imaging Scanners: These imaging scanners provide the quantum state data used to assemble the matter stream. These systems have undergone a considerable revision, especially as they are implemented in the emitter array (the emitter array is bulkier, and takes up slightly more room on the outer skin of the vessel due to the required size for the imaging scanners). These scanners have an improved resolution through and increased penetration of hostile environs such as high radiation fields and intense electromagnetic fields. The technology does not yet allow beaming through operational shielding, but does give superior performance to a standard transporter in most hostile situations.

Pattern Buffer: Since both technologies use similar pattern buffers, this system has undergone no major changes in design other than those necessary to accommodate the other changes, such as raising the energy capacity by a slight percentage.

Biofilter: This system incorporates the sum of Federation and Klingon knowledge of biological hazards to both species, but, other than these software upgrades, has undergone no major changes in its basic technology.

Emitter Array: This assembly has also undergone considerable uprating with the addition of the enhanced molecular imaging scanners mentioned earlier. The system has also had its actual emitter capacity increased to allow for more accurate lock-on to target in



Below: Three of the *Khai Tam's* 16 transporter emitter arrays can be seen in this drawing (circled oblong blocks). The forward separable hull RCS packages and the elliptical personnel tunnel connectors (see Chapter 8) are also clearly visible on either side of the bridge.

hazardous situations. However, the enhancements have increased the size of the emitter array by 15%, and has required the array to be slightly expanded into the ship.

Targeting Scanners: These scanners, located in the sensor arrays, have been greatly enhanced to insure lock-on under the harshest conditions. Most of this technology was Klingon in origin, but Federation engineers managed to refine and streamline the rather ungainly Klingon layout to incorporate it into the new design.

Operation Sequence & Duty Cycle

The transporter operation sequence on the *Khai Tam* is essentially the same as that of the *Galaxy* or *Nebula*. One or two microsecond variations in the time indexes of the sequence may occur. The entire sequence takes approximately five seconds, with slight variations due to power availability and transport payload.

Although the transporter sequence itself lasts only five seconds, the redesigned transporter systems require an average of 93 seconds for pattern buffer cool-down and reset due to the increased power usage. This yields an average duty cycle of approximately 98 to 100 seconds, depending on payload capacity. Since the matter stream can be routed through any of the four transporter buffers, the transport process can be repeated three times before waiting for pattern buffer reset. This results in an average of 2.28 six-person transports per minute, or a system capacity of just over 800 persons an hour.

Transporter Evacuation

By its very nature, transporter usage is critical in any large-scale movement of personnel to or from a *Qapla'* class vessel. However, the usage of transporter systems imposes restrictions on evacuation procedures.

Evacuation To Ship

If a situation arises wherein evacuation to the ship would be required, all eight personnel transporters as well as the cargo transporters would be brought into use. The personnel transporters have a system capacity of approximately 800 persons per hour, while the cargo transporters (once reset for quantum-level transport) contribute an additional 250 persons capacity per hour. This yields a total system capacity of 1050 persons per hour in evacuations to the ship. The medical transporter would be used in this situation to evacuate the most seriously wounded and/or incapacitated after which it can be used for further evacuation duties.

Evacuation From Ship

Emergency beam-down operations can be accomplished much quicker than beam-up operations due to the addition of the emergency transporters to the system. These transporters are capable of transporting 22 persons off the ship at one time by utilizing high-volume phase transition coils which can only scan targets, not receive incoming signals. The use of these transporters in addition to the cargo and personnel transporters raises the evacuation capacity to approximately 2300 per hour.

In a reduced-power situation, the emergency transporters can be used alone, since they require much less power than the personnel transporters. However, due to their longer degaussing time, their evacuation rate is only about 800 persons per hour.

11
Auxiliary Spacecraft Systems

The *Khai Tam* currently carries a greater number and variety of auxiliary spacecraft than any other ship in Starfleet save the *Oriskany* and *T'Plah* class shuttlecarriers. The *Khai Tam* embarks standard passenger and cargo craft, as well as two Runabouts and several smaller tactical craft. At first glance, the extensive shuttle operations capability of the ship seems unjustified until one considers the original role *Khai Tam* was to play in the fleet.

When tasked primarily as a defensive platform, the initial design of the *Qapla'* class allowed for expanded shuttle operations in order to embark several squadrons of tactical shuttles and attack craft. Although the primary role for these ships was changed, the change came late enough in the design process so that the shuttle support facilities were already in place. Therefore it was decided that the mix of auxiliary craft would be changed, but that the expanded shuttle operations capability of the *Qapla'* class ships would remain.

Due to its extensive capabilities in this area, shuttle operations aboard *Khai Tam* are very complex. The careful orchestration of flight operations, logistics, maintenance, and repair fall under the purview of the Shuttle Operations Department or "Shuttle Ops" for short.

Shuttlebays

Shuttle Ops has the enormous responsibility of maintaining and operating nearly ninety auxiliary craft of eleven different types. Primarily, these operations are conducted from the Main Shuttlebay on the ventral side of the primary hull. Shuttlebay 2, located in the aft portion of the separable hull, supports only passenger shuttle operations and limited cargo shuttle ops.

The Main Shuttlebay houses launch and recovery facilities as well as maintenance and repair facilities for the bulk of the ship's auxiliary craft. The extensive repair facilities include fabrication shops and enough hangar space to completely overhaul several Type 9A cargo shuttles. In fact, the *Khai Tam's* shuttle maintenance facilities are so complete, she has already been called upon twice to render shuttletender service to other ships (once to the *Galaxy*, once to the *Phoenix*). The main shuttlebay houses a dedicated repair facility for sensor pallets as well.

The most notable feature of the Main Shuttlebay is the orientation of the flight deck to the rest of the ship. For ease of operations, the flight deck is inverted with respect to the rest of the vessel. This means that the doors, which are on the "bottom" of the primary hull are actually above the head of a person standing on the flight deck, and shuttles leave the bay "upside down" with respect to the ship. This is easily accomplished through careful manipulation of the artificial gravity systems in decks 17 and 18. Of course, any seasoned space traveller can tell you that "up" is an arbitrary direction

assigned for comfort on a space vessel, and the *Khai Tam* is not the first vessel to use inverted decks. It is, however, sometimes disorienting to new crew members when they make the transition from the hangar deck (deck 17) to the flight deck (deck 18).

Shuttlebay 2 is much smaller and houses only nominal maintenance facilities for Federation Type 15 & 16 shuttlepods, Type 7 shuttles and Klingon GF2 shuttlepods. It is large enough to support launch and recovery of up to a Federation Type 9A, but more commonly supports only passenger shuttle operations. This frees the main shuttlebay from the congestion of small but frequent passenger traffic.

Shuttle flight operations are controlled by Primary Shuttle Flight Control (Pri Flight) located on deck 18. Each shuttlebay has a flight deck officer (FDO) on-duty at all times to manage taxi, launch and recovery operations in their respective bays. Each FDO coordinates their activities through Pri Flight who has the authority to grant or deny launch and recovery clearance under normal cruise mode. On yellow or red alert, Pri Flight must defer to the Operations Manager on the bridge.

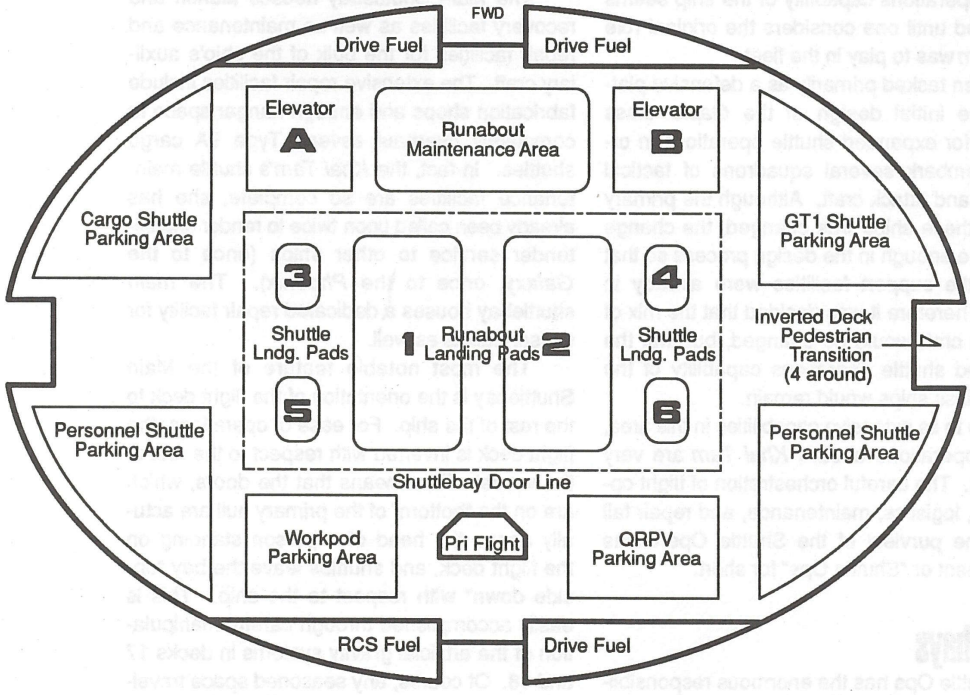
Shuttlecraft

The eleven types of auxiliary craft currently embarked on the *Khai Tam* include six types of Federation shuttles, three Klingon types, and two remotely piloted types specifically designed for the *Qapla'* class program. The Klingon-variant ships carry roughly the same amount of ships, but in a mixture that more heavily favors Klingon craft. The performance of the Federation and Klingon shuttles are roughly equivalent (except for the significantly larger cargo capacity of the Type 9A) and their use depends mostly on crew familiarity with the vessels.

Federation Shuttles

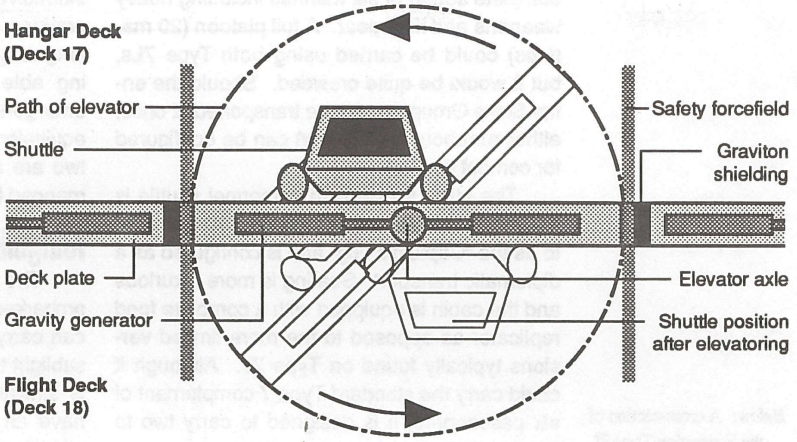
The smallest auxiliary craft aboard the *Khai Tam* are ten type M1A workpods used for extravehicular maintenance and repairs. Eight of the workpods can have their manipulators replaced with Type II phasers within ten minutes, converting them into the familiar "Killer Bee" configuration. The other two are fitted with heavy-duty hull plate manipulators which cannot be easily removed.

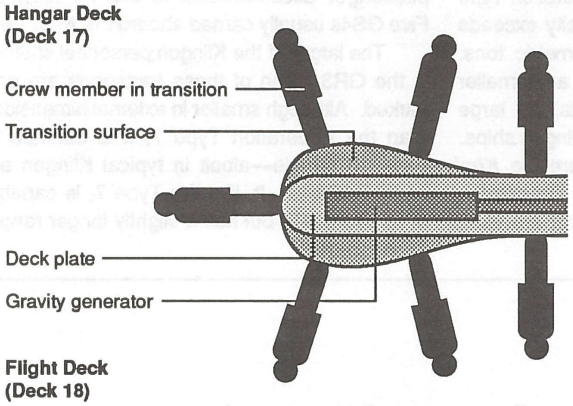
Below: Floor plan of the Main Shuttlebay's flight deck. Spacecraft taxi and parking areas can be rearranged as needed.



Spacecraft Elevator

Although called an elevator, this device is actually more like a pivoting trap door. Since the gravity is generated in the deck plate itself, the elevator area simply rotates 180° so that anything on it starting on the hangar deck winds up on the flight deck and vice versa. Before rotating, a warning klaxon sounds and a safety forcefield activates to keep personnel and equipment from being caught in the transition inadvertently. Graviton shielding in the deck plate around the elevator keeps the deck gravity from interfering with the elevator gravity.





Pedestrian Transition

Four bulbous pedestrian transitions allow crew members to simply walk from hangar deck to flight deck. The bulbous strcture at deck's end is shaped to allow a gradual transition with even gravity so that no unusual effort is required to go from deck to deck. The gravity generator is carefully placed so that there is a stable gravimetric field in the center of the bulb, giving a constant feeling of "down" to all seven crewmembers in the illustration. Kinesthetically, the crewmember feels no unusual effects. Visually, however, the experience can be disorienting the first few times.

Above: The methods used to get spacecraft and personnel between hangar deck and flight deck. The transition is simple, but travelling onto an inverted deck can be disorienting.

The *Khai Tam* embarks 16 shuttlepods. Ten are type 15A light short-range sublight shuttles capable of carrying two persons, and six are type 16A medium short-range sublight shuttles capable of carrying three persons. These shuttlepods are typically used by Federation crew members for short-range trips or extravehicular activity. Klingon crew members generally prefer to use the GS4 shuttlepods (see below) mostly out of familiarity with the vessel.

The standard for personnel transportation aboard the *Khai Tam* is the Type 7 personnel shuttle, of which 15 are usually carried. This eight-person shuttle can travel at warp 2 and is used for shuttling small contingents to and from the ship. The Type 7 is almost always preferred to the Klingon GR3 for its comfort. The GR3 (see below) is used exclusively by Klingon exchange crew members or when transporting Klingon personnel.

Of the 15 Type 7s aboard, three are specially modified versions. Two are Type 7Ls used by the Marine Detachment for covert or rapid insertion/extraction of personnel in hostile areas. The Type 7Ls have more powerful phaser emitters, more extensive sensor countermeasures, a low-energy transporter unit, and a rear fast-folding door for rapid ingress/egress. It also has several exterior compartments for additional combat/survival gear.

The Type 7L has spartan accommodations that allow room for more passengers in combat seating positions. The cabin has no food replicator and only bench seating. Each Type 7L can carry a pilot, mission commander, and a

complete squad of six marines including heavy weapons and field gear. A full platoon (20 marines) could be carried using both Type 7Ls, but it would be quite crowded. Should the entire Strike Group need to be transported at once, either runabout (see below) can be configured for combat seating.

The other specialized personnel shuttle is a Type 7D. This shuttle is commonly referred to as the "Captain's Gig" and is configured as a diplomatic transport. Seating is more luxurious and the cabin is equipped with a complete food replicator as opposed to the more limited versions typically found on Type 7s. Although it could carry the standard Type 7 complement of six passengers, it is designed to carry two to four in comfort.

For transporting cargo, both Klingon and Federation variants embark ten Federation Type 9A cargo shuttles. Its cargo capacity exceeds the Klingon GF1 by almost two metric tons. Being as most Klingon warships are smaller than their Federation counterparts, no large shuttles were ever developed for Klingon ships.

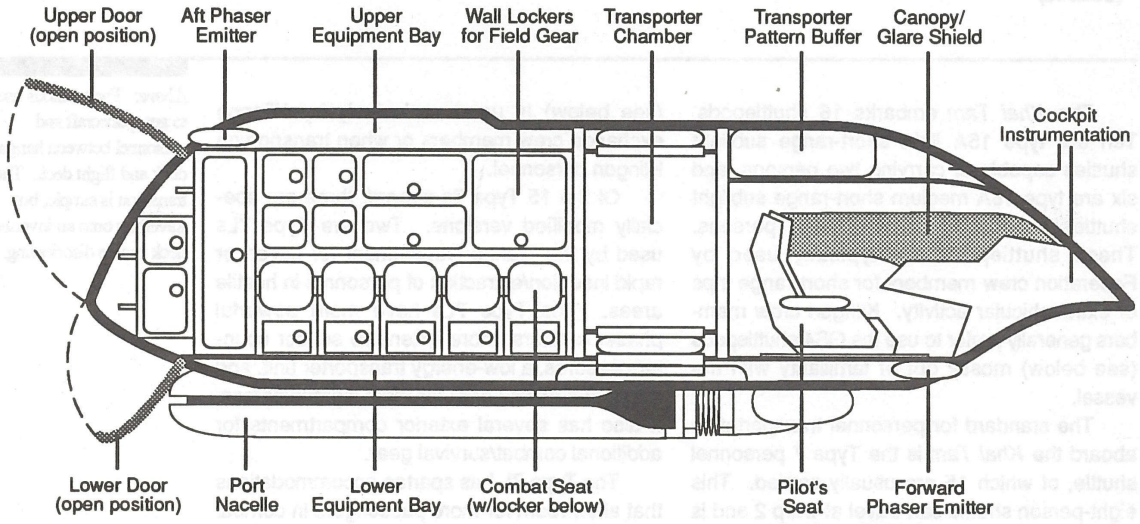
Last, but certainly not least are the *Khai Tam's* two Federation Runabouts. These relatively new, highly warp capable craft are used extensively in planetary survey and special operations. They can also be used for quick long-range personnel transport evacuation (being able to carry about 100 humanoids in emergency seating configuration). There is no equivalent craft in the Klingon inventory, and so two are also carried aboard *Qapla'* and *Targ*, manned by Starfleet-exchange flight crews.

Klingon Shuttles

The first type of Klingon auxiliary craft embarked is the standard GS4 shuttlepod, which can carry up to two individuals for short range sublight travel. In most characteristics, the GS4 is similar to the Type 15A, although it does have an emergency-use-only warp drive that can propel it at warp 1.3 for two hours. Because of this it is slightly larger than a Type 15, but its passenger accommodations are no roomier. Five GS4s usually carried aboard the *Khai Tam*.

The larger of the Klingon personnel shuttles is the GR3. Ten of these transports are embarked. Although smaller in external dimensions than the Federation Type 7, it is outfitted to carry 12 people—albeit in typical Klingon accommodations. It, like the Type 7, is capable of up to warp 2, but has a slightly longer range.

Below: A cross-section of the Federation Type 7L shuttle. Used for insertion/extraction of combat troops, there are few comforts. Every available space is used for gear storage, combat seating, or for the low-energy, two-person transporter amidships. The exterior of the shuttle is covered with a flat black sensor-absorbent hull coating.



It is also the oldest of the Klingon shuttles aboard the *Khai Tam,* as it has been in service with the Empire for almost 30 years.

The most notable of the Klingon Shuttles are the GT1s. The GT1 is a one-person shuttle roughly the size of a Type 9A Federation cargo shuttle. The GT1 is essentially a flying torpedo tube and loader with a pilot strapped in on top of it all for good measure.

The shuttle is built around a standard 10 meter torpedo tube which lies more or less on the centerline (actually it is difficult to define a centerline on the GT1). Five torpedoes are stored in a semicircular loader which actually wraps around the cockpit, and one torpedo is carried in the tube.

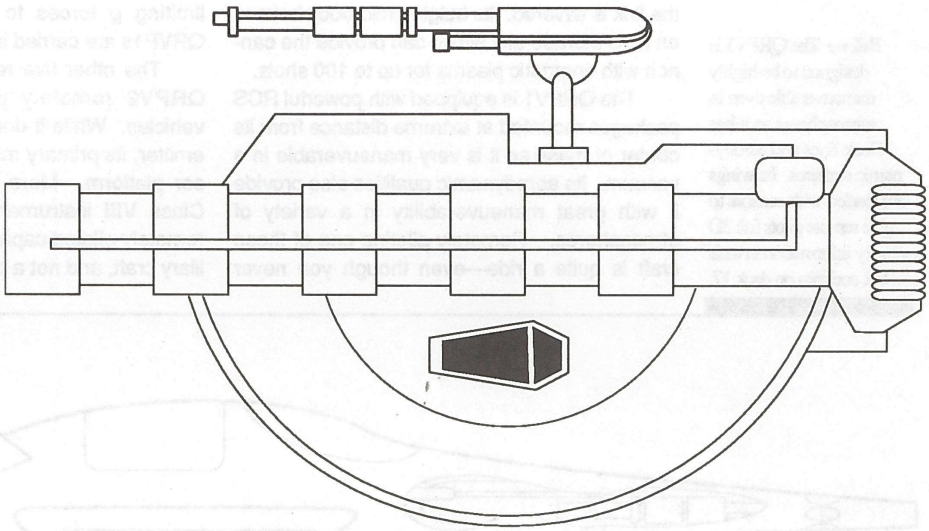
On the other side of the torpedo tube from the loader and cockpit, a small disruptor cannon is mounted on a pivoting shoulder joint which allows the disruptor to cover a field of fire about 220° around the centerline.

Between the movement of the cannon and the changing weight of the loader as torpedoes are used, the GT1s center of mass is constantly shifting—and usually at the worst moments. Combine this with its asymmetrical RCS packages and very limited cockpit visibility and it becomes an ungainly craft to fly. Great skill is needed by its pilots—but it *is* a very lethal weapon. Smaller than a Federation Runabout, it packs about 1/4 the firepower of a Klingon bird-of-prey!

Its normal cruising speed is warp 1.5, but it is capable of warp 3 for short periods. It is extremely inefficient in fuel usage and accordingly has a limited range. This somewhat restricts its usage, but it is appropriate in many tactical situations—most notably in stalling a secondary target while engaging a primary target.

A squadron of six of these shuttles operate through the main shuttlebay. This part of the Klingon exchange crew rotates on and off the ship as a unit with the pilots and technicians staying together from assignment to assignment. GT1 squadrons are elite units with good reason—they comprise some of the finest combat pilots and technicians in the Empire.

It was originally planned to have two additional squadrons operating out of four dedicated GT1 launch hangars in the structural ring of the *Qapla'* class ships. That space was dedicated to sensor arrays when the class mission objectives were changed to be more exploratory in nature, so the additional squadrons were never taken on.



Above: Top view of the Klingon GT1 shuttle. Hard to fly and harder to look at, the GT1 is still a powerful weapon. Its constantly shifting center of mass and asymmetrical RCS packages make it hard to handle, and the nature of her missions are usually very dangerous. For these reasons, GT1 pilots belong to an exclusive cadre with high esprit-de-corps.

Remotely Piloted Craft

The *Khai Tam* carries ten remotely piloted vehicles in the main shuttlebay. Both craft were designed specifically for the *Qapla'* project, and both are designated QRPVs (Qapla' Remotely Piloted Vehicle). They are piloted from virtual reality cockpits on deck 17.

The first, the QRPV1, is basically a remote controlled GLG-11 disruptor cannon. About half as high and more than twice as long as a Type 15 workpod, this craft was designed from scratch to be atmosphere-capable and to be able to carry a fight to distant targets quickly.

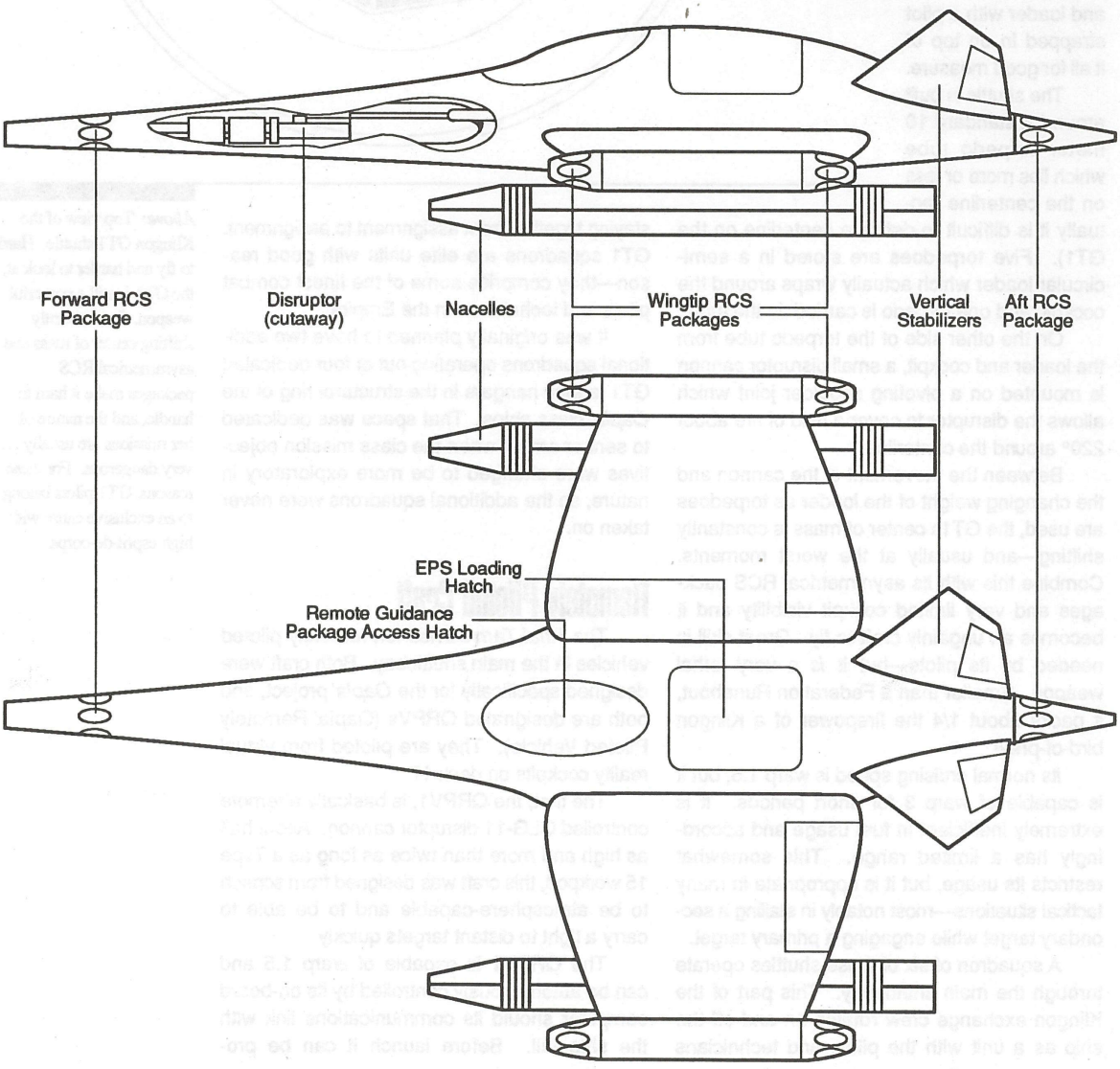
The QRPV1 is capable of warp 1.5 and can be autonomously controlled by its on-board computer should its communications link with the ship fail. Before launch it can be pro-

Below: The QRPV1 is designed to be highly maneuverable even in atmospheres so it has sleek lines and aerodynamic surfaces. Its wings are loaded with sensors to give remote pilots full 3D sensory information in their VR cockpits on deck 17.

grammed with a specific attack profile, but more typically it is programmed to return to the ship if the link is severed. Its bulging mid-body houses an EPS storage unit which can provide the cannon with energetic plasma for up to 100 shots.

The QRPV1 is equipped with powerful RCS packages mounted at extreme distance from its center of mass so it is very maneuverable in a vacuum. Its aerodynamic qualities also provide it with great maneuverability in a variety of atmospheres. Remotely piloting one of these craft is quite a ride—even though you never leave the ship, the VR cockpit gives you every sensory input you would get on board, save for limiting *g* forces to pilot-safe levels. Five QRVP1s are carried in the main shuttlebay.

The other five remote craft are the small QRPV2 remotely piloted reconnaissance vehicles. While it does carry a type IV phaser emitter, its primary mission is as a remote sensor platform. More than twice the size of a Class VIII instrumented probe, its size and remotely piloted capability classify it as an auxiliary craft, and not a probe.



12
Science & Remote Sensing Systems

Originally, *Khai Tam* and her sister ships were to be fitted with only enough of a sensor package to meet their tactical objectives. After the battle at Wolf 359, scientific exploration was not the first thing on most people's lists of "reasons we need a new starship."

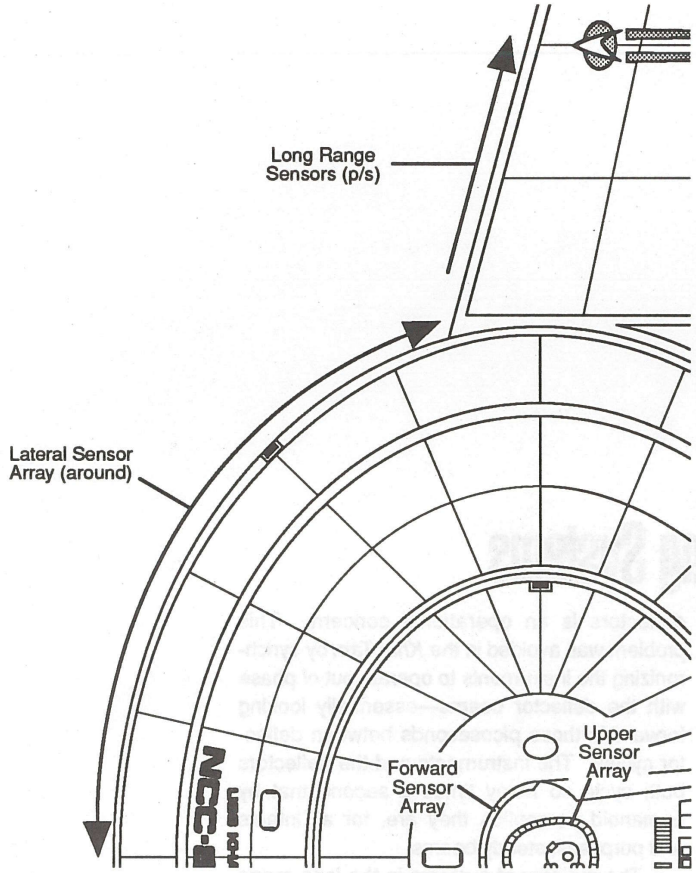
However, after the Borg threat was curtailed and the *Qapla'* class mission objectives changed, a lot of rethinking went into the *Khai Tam's* sensor fit. A much broader range of instruments were placed aboard, especially in the lateral arrays, and more powerful instruments were selected for the long-range sensor package. Her two outermost torpedo tubes—originally intended to be automated Type 1 torpedo launchers—were converted into dedicated probe launchers and her compliment of probes was significantly increased. Overall, her sensor package was upgraded to be almost as extensive as the *Galaxy's*—which is why the Heavy Cruiser-Exploratory class designation was created for the *Qapla'* class ships.

Long-Range Sensors

The leading edges of each wing assembly are packed with long-range sensor emplacements. In fact, each wing is outfitted with identical redundant packages (owing once again to the Klingon propensity for redundant system coverage). Most of these instruments are designed to sense EM, subspace or gravimetric phenomena, so interference by the navigational deflectors is an operational concern. This problem was avoided in the *Khai Tam* by synchronizing the instruments to operate out of phase with the deflector beams—essentially looking forward in those picoseconds between deflector cycles. The instruments and the deflectors both cycle so many times a second that by humanoid perception they are, for all intents and purposes, steady beams.

The majority of systems in the long range arrays are active-scan subspace and tachyonic devices. This means that information can be gathered at speeds exceeding light which is a necessity when you are travelling faster than light. Unfortunately, it also means that low-grade subspace distortions are being projected far ahead of the ship (much farther than the navigational deflectors), alerting a potential threat to the approach of the ship if they are scanning for such disturbances. In tactically sensitive situations, there is always a fine-line between information needed and information given away. For this reason *any* active sensor may not be activated without authorization from the OD when the ship is on alert status.

The remainder of the long-range instruments are passive computer-enhanced optical devices (telescopes) and passive EM sensors which are highly sensitive to a variety of EM disturbances. Small passive gravimetric packages of Klingon design are also installed, as are subspace distortion sensors that can pick-up exactly the type of low-level distortion



Above: Sensor array placement on the *Khai Tam*. The lateral sensors encircle the primary hull for most of its circumference, and the long range sensors extend almost the full length of the wing.

long-range subspace scanners produce. A passive neutrino imaging sensor is also installed in each wing.

The long-range systems can, at maximum power, scan far ahead of the navigational deflector, but they are more routinely used at lower power to scan just ahead of the deflectors in order to target micrometeors and other small debris for the deflectors. When used in this capacity, the processed data from the sensors is fed to the Conn position in both the Main Bridge and CIC. Individual sensors may be tasked separately for scientific study and raw or processed data from any sensor can be fed to any science lab or bridge/CIC station.

Navigational Sensors

Space is an easy place in which to get lost —a course deviation of a fraction of a degree can result in going light-years off course in just a few seconds at warp speeds. A starship must therefore know its exact position in the galaxy at all times. To do this, the *Khai Tam* is outfitted with two complete navigational sensor packages to sense galactic phenomenon as well as ship attitude. Other associated sensors are included in the lateral array, and data from the long-range sensors is routinely fed through the navigational subprocessors as well. The navigational subprocessors prioritize sensory data according to flight mode and tactical situation data. These priorities can be overridden by the Flight Controller if other data is preferred.

Most navigational sensors are passive in nature so they may be used at any time without revealing the ship's position to an adversary. Optical sensors look for key stellar phenomenon like quasars, nebulae and stellar pairs in order to give reference points to the system. Such points are also obtained through passive subspace multibeacon receivers and timebase beacon receivers. Other sensors include IR-UV-Gamma Ray imagers and charged particle detectors. Over 300 separate instruments comprise the navigational arrays with 100 in the forward array, and the other 200 distributed around the lateral array.

The ship's guidance is also handled by an inertial guidance system (IGS) based on seven laser gyroscopes located around the ship and stabilized on the galactic plane. Multi-data pickups on the gyroscopes allow the ship to know where it is at all times—in relation to its last positional input—without any external data. This positional input is made automatically by the navigational subprocessors before leaving any Starfleet docking facility (this fixed-point input is known as the "initial fix"). It is updated consistently from navigational sensors while underway. Should navigational sensors become defective or their data suspect, the Flight Controller can erase any inputs all the way back to the initial fix to obtain the IGS position readout. The more inputs erased, however, the more the margin for error, albeit minimal in any case, increases. The IGS is especially helpful inside nebulae or around bright bodies that obscure external reference data.

The actual processing routines used for navigational data are similar to those used on most Starfleet ships. The *Khai Tam* is unique, though, in the respect that it has the collected Klingon star chart database as well as the Federation equivalent. This increases the reliability

of course solutions and positional fixes by as much as 120% depending upon the operational area the ship is in.

Lateral Sensor Array

Around the perimeter of the primary hull is a series of Federation-standard instrument pallets that are collectively referred to as the lateral sensor array. The pallets can vary widely in instrumentation and may carry anything from subspace field distortion sensors to x-ray telescopes to tachyonic life-form scanners.

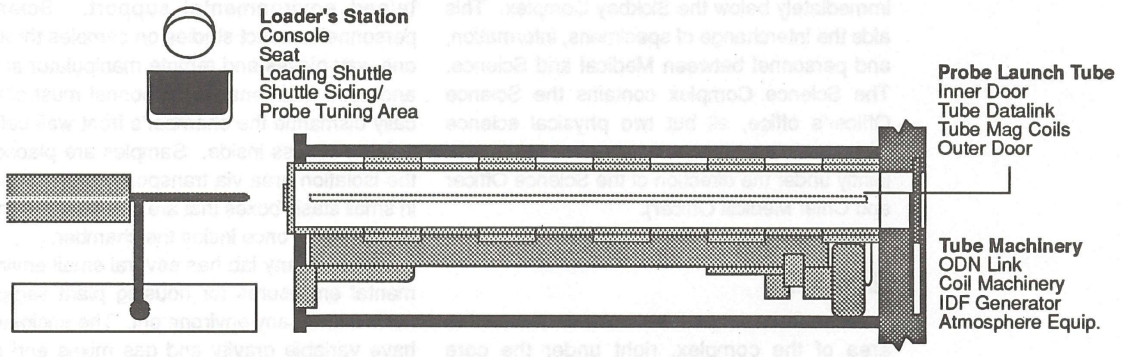
About 20% of the pallets are navigational sensor packages, about 75% of which are in use at any one time (navigational sensors have a much more frequent periodic maintenance schedule than most sensor pallets). 50% of the pallets in the lateral array are configured in the standard six-pallet Starfleet science sensor package. The remaining 30% of the pallet spaces can be configured as necessary for scientific missions. A smaller number of similarly configured pallets are arranged in a ring around the Main Bridge superstructure and on strips to fore and aft of the main shuttlebay doors. These pallets accommodate sensor readings in the extreme elevations and give sensor capability all the way to the zenith and nadir.

It was in the lateral sensor array that the biggest system changes occurred when the mission objectives for the class were revised. Originally, the lateral sensors were only to run down the sides of the primary hull. The forward and aft areas of the perimeter were mostly going to be used for ordnance storage and deployment equipment—including an additional disruptor cannon in the forward section and four dedicated GT1 launch bays (see chapter 11). When the new mission objectives were established, most of the plans for these items were scrapped in favor of more sensor packages and support equipment. The new higher pallet number also increased the number of workpods (used to replace and repair pallets) embarked at the expense of several planned QRPVs.

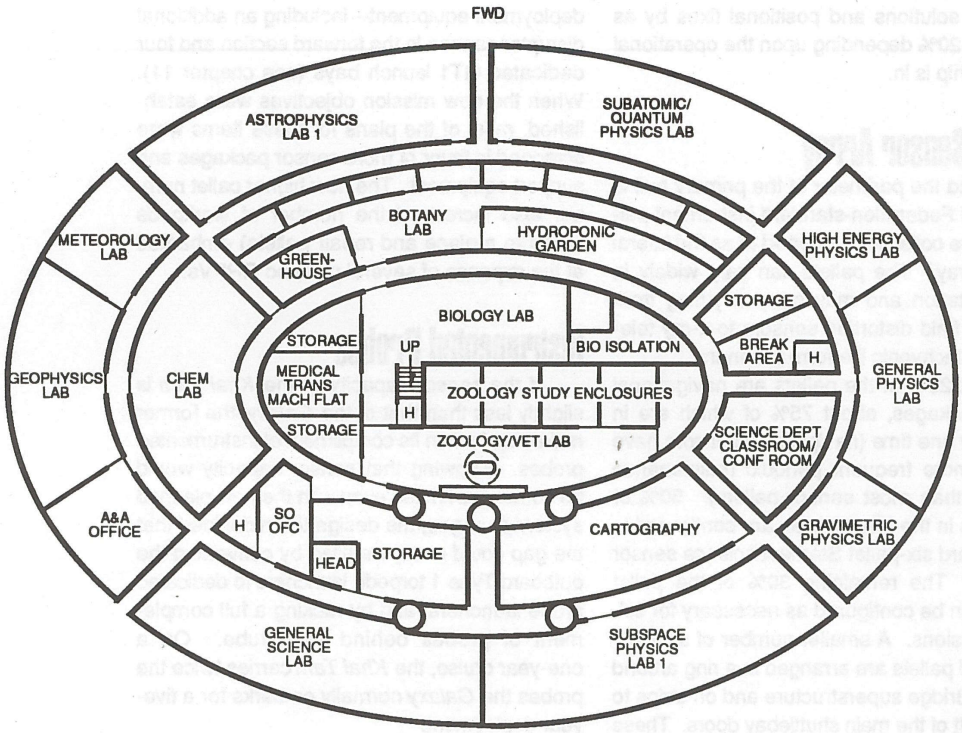
Instrumented Probes

If the sensor capacity of the *Khai Tam* is slightly less than that of the *Galaxy*, the former makes up for it in its compliment of instrumented probes. Knowing that sensor capacity would be somewhat limited even with the new planned system changes, the design team decided that the gap could easily be filled by converting the outboard Type 1 torpedo launchers to dedicated probe launchers, and by racking a full complement of probes behind each tube. On a one-year cruise, the *Khai Tam* carries twice the probes the *Galaxy* normally embarks for a five-year deployment.

Behind each probe launcher are the five-high torpedo rack and loading systems found in torpedo bays 1, 2 and 4. On the five racks of Probe Launch 1 (formerly torpedo tube 1) are 15 probes each of Classes I through V. Behind Probe Launch 2 (formerly torpedo tube 8) are four racks of 15 probes each of Classes VI through IX, and one rack of 15 class VIII/IX spaceframes ready to be fitted with custom instrument packages. The standard Federation



Below: Floor plan of Probe Launch 2. The similarities between this and the torpedo launchers are not accidental—this was to be a Type 1 torpedo launcher before the class mission objectives changed.



Above: The Science Complex on Deck 10. The complex inhabits the entire inner portion of the deck (just to port and starboard of this illustration would be the computer cores).

probes are used on the *Khai Tam* mostly for system compatibility and crew familiarity. The *Qapla'* and *Targ* carry eight racks of the four standard Klingon probes and two racks of Class IX Federation probes (there is no Klingon long-range warp-capable equivalent).

Science Labs

Most science labs aboard *Khai Tam* are located in the Science Complex on Deck 10 immediately below the Sickbay Complex. This aids the interchange of specimens, information, and personnel between Medical and Science. The Science Complex contains the Science Officer's office, all but two physical science labs, and the life sciences labs (which fall jointly under the direction of the Science Officer and Chief Medical Officer).

Life Sciences

The life science labs reside in the central area of the complex, right under the core Sickbay unit since these two departments have the most interchange. In fact, there is a ladderway between the two so that waiting for a turbolift is not necessary. Life science labs include a complete biology suite, a zoology lab, and a botany lab.

The biology lab houses specialized sample containers and analysis instruments for complete microbiology, exobiology, biochemistry and biophysics panels. It has a small isolation area to keep and study quarantined samples. This isolation area is closed off from the rest of the ship in every way and has its own self-contained environmental support. Science personnel conduct studies on samples through one-way gloves and remote manipulator arms, and even maintenance personnel must physically dismantle the chamber's front wall before gaining access inside. Samples are placed in the isolation area via transporter only—usually in small stasis boxes that are opened via remote manipulators once inside the chamber.

The botany lab has several small environmental enclosures for housing plant samples from virtually any environment. The enclosures have variable gravity and gas mixes and can even be filled with water for aquatic plant specimens. A standard Class M greenhouse is

available for collected samples, for cultivating specimens that will be transferred to the arboretum, or for caring for sick/damaged plants from the arboretum or those belonging to crew members. A hydroponic garden is used to study this cultivation technique on new plant samples. It also produces a variety of fresh produce which is highly prized aboard ship and is usually available to crew members through the ship's store. The lab also has a direct plumbing connection to the ship's graywater supply for watering compatible flora (see chapter 13).

The zoology lab is perhaps the most unique of the life sciences labs. It has a small veterinary care unit which can care for crew member's pets as well as fauna aboard for study. The zoological specimen study area is the lab's most unique feature though. Four enclosures in the lab are complete holosuites which can be programmed with the environment of any planet the ship may study. An animal in one of these enclosures is absolutely convinced it has never left its natural environment.

This method of study leads to much more accurate data regarding an animal's behavior patterns on its home world. For transport or when the holographic simulation must be suspended (during emergency power situations for example) a projected "neural caliper" beam sedates the animal with no ill effects. The animal can be re-sedated in this manner as many times as necessary with no health effects.

Of course, under ideal circumstances animal or plant samples are studied on their home world and never taken from their environment. The zoology and botany facilities are ideal, however, when the circumstances aren't.

Physical Sciences

The physical science labs occupy much more of the complex than the life science labs do. There are a much wider variety of disciplines represented in the physical sciences, and the study of most of them is done in space, so actually finding a planet to produce study specimens is not necessary (as it is for life sciences).

The most important labs are in the physics area, especially in the astrophysics, subatomic/quantum physics, and subspace physics areas. These disciplines study a wide variety of phenomena that the ship encounters on a regular basis, and they are staffed around the clock. In fact, there are secondary astrophysics and subspace physics labs in the separable hull in case such study in separated flight mode is required. Other physics labs in the complex include gravimetric, high-energy, and general physics facilities. Most of these labs collect their data through the scientific packages in the lateral, upper, and lower arrays, although data from any sensor can be routed to any lab for analysis. The Ship's Physicist coordinates all six physics labs and is usually the second-in-command of the Science Department.

The Planetary Geologist (third-in-command of the department) is in charge of the three geology labs that do the bulk of planetary study in the physical sciences. These labs include a geophysics facility, a meteorology lab, and an archeology & anthropology facility. The geochemistry group reports to the Planetary Geologist, but they do most of their lab work in the chemistry lab next to the geology suite. Also reporting to this section is the ship's Oceanographer who is cross-trained in marine biology and meteorology (their work station is in the meteorology lab).

The chem lab houses complete analytical facilities to identify any unknown compound encountered in space or on a planet or other body. This lab also aids the general medical and life science labs in biochemistry studies and drug identification/synthesis. The chem lab is capable of synthesizing and replicating many known chemical compounds if it can be supplied with the correct raw materials. This method of synthesizing is used when quantum resolution of the material must be correct (as in certain medicines) because replicators function only on the molecular resolution level.

The cartography section includes both stellar and planetary groups. Stellar cartographers study and chart the placement of stars, stellar phenomenon, and planetary bodies while the planetary cartographers chart the actual surface features of planets, asteroids, moons, or other similar bodies. Most planetary cartographers are cross-trained in stellar cartography so they can assist in that groups' studies when no planetary work is needed.

The general science lab is equipped with a wide variety of broad-use instrumentation and is assigned studies which do not fall specifically in one of the other disciplines aboard. This lab gets quite a variety of projects, and being posted in this area is a real learning experience for most new scientific personnel.

13
Environmental Systems

Life Support and Environmental Control

In the technology of environmental control, both the Empire and the Federation have excelled at providing their crews with living conditions almost identical to their home worlds; though on the *Khai Tam* mainly Federation technology was used because Federation habitation modules were used (see Chapter 2). This means that, like the *Galaxy*, her environmental and life support systems are located primarily on Decks 6, 9, and 13. Because she has no engineering hull like the *Galaxy*, her two primary systems are divided into port and starboard redundant units.

In addition to the primary systems, large quantities of reserve air, water, etc. are stored in specially armored tanks around the structural ring. As a last resort, there is a four day supply of air and water stored in the center of the primary hull on Deck 11.

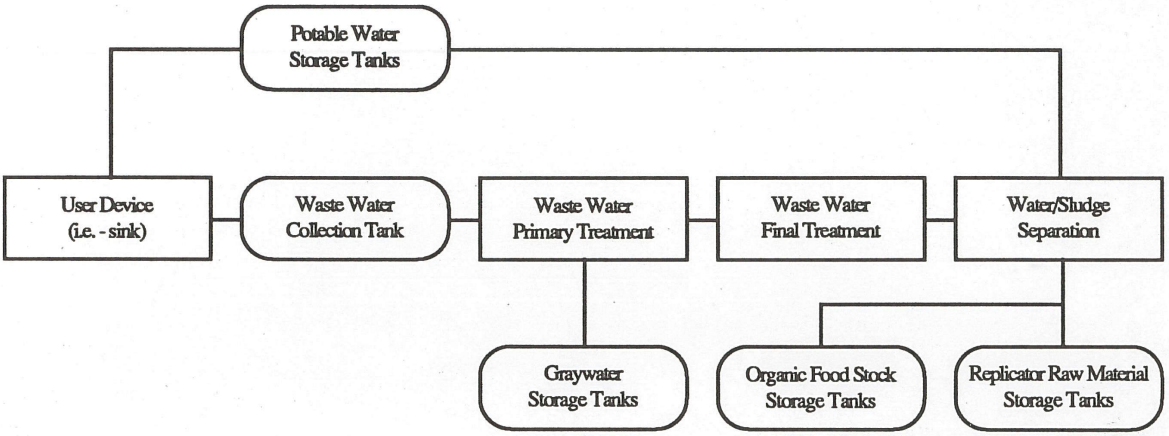
Other emergency provisions include the designation of emergency shelter areas, personal emergency life support systems distributed throughout the ship, and contingency support modules which provide breathable atmosphere for up to 30 minutes in the case of catastrophic systems failure. Emergency environmental protocols are similar to those on a *Galaxy* or *Nebula* class ship.

Atmospheric System

As in any starship, the atmosphere aboard the *Khai Tam* is carefully monitored and regulated. Two completely redundant primary systems and myriad redundant back-ups assure that under normal cruise mode the atmosphere will be comfortable and uninterrupted. Atmosphere processors analyze incoming waste products at least 40 times a second to assure that outgoing gases are of the correct mixture, temperature, and pressure to maintain a standard Class M environment. Any variation of more than 1% from nominal values is called to the attention of environmental engineering.

All public spaces aboard the *Khai Tam* are maintained at SFRA-standard 102.19 levels for Class M conditions: temperature = 26°C, relative humidity = 45%, atmospheric pressure = 101 kilopascals, and gas ratio = 78% nitrogen/21% oxygen/1% trace gases). Private spaces can be modified in any of these dimensions. If any major modifications are made in pressure or gas ratio, the door to the compartment locks until the modified levels can be returned to normal (unless emergency override is activated).

Twenty-five percent of the living space aboard the *Khai Tam* can be converted to Class H, K, or L environments, and 10% is further convertible to class N or N(2) conditions. These convertible rooms have small airlocks at their



Above: An example of the efficient reuse and recycling of waste products aboard *Khai Tam*. In the case of potable water, nothing is left as waste. Even inorganic material can be reused as replicator raw material.

entrance, so few modifications are needed for conversion. Crew members requiring such special environmental conditions are allowed to work in their quarters if their job permits. They are also issued personal life support suits so that they may roam freely about the ship.

Because the bulk of the ship is not naturally hospitable to these life forms, duty for one of them aboard the *Khai Tam* can be an isolating experience. Therefore, their recreation program is of utmost importance to their satisfaction and well-being. The recreation department regularly sets aside holodeck 12 for use by these life-forms, bumping even senior officers, so they can take part in a full recreation program aboard ship (see Chapter 14).

Gravity Generation

Gravity aboard the *Khai Tam* is provided by a network of over 400 synthetic gravity generators which use controlled streams of gravitons to create a nominal gravity of 1*g*. On every deck but Deck 18, generators in the "floor" (ventral deck plate) create a sense of "down" for the entire ship. The graviton fields from the deck above are shielded from the ceiling of the deck below so that conflicting fields do not provide problems with nominal gravity.

On Deck 18, no shielding is provided in the ceiling and no generators are used in the floor. The result is that operations on this deck (which houses the main shuttlebay) are inverted from the rest of the ship (see Chapter 11).

Many areas of the ship are designated as "variable gravity areas" (VGAs). A VGA is defined as any space in which the nominal synthetic gravity can be varied from 0*g* to 2*g* by an individual in that space (rather than by main environmental control). Shuttle and cargo bays, some sickbay and science spaces, holodecks, and the convertible living spaces are some of the areas aboard designated as VGAs.

Waste Management

The area of waste management is where the Klingon design team contributed its greatest effort in environmental systems design. On a Klingon ship, waste is frowned upon most vehemently. For decades the Klingon economy was weighted so heavily on defense hardware, that every scrap of waste in any other area was a potential threat to the empire's stability. Therefore, sophisticated waste recovery systems were developed by the Klingons, and much of that technology has been used in the design of the *Qapla'* class ships.

Water and Sewage Recycling

Nearly 100% of the waste water and sewage generated by the crew can be recovered and used either as water or as organic raw material for the food replicator system. This is accomplished through rigorous processing and sterilization of the waste products. Through a number of steps, the liquid waste is separated into water and sludge. The water is then sterilized and sent back to potable water storage. The sludge is further processed and sterilized and sent to raw food stock storage. The small

amount of unrecoverable inorganic waste remaining is stored for matter replication recycling.

To save on energy costs, some waste water is diverted for use after only its primary treatment. This "graywater" still contains some organic waste and is not potable, but is extremely useful in watering plants in the arboretum and in the botany labs because of its organic content. Crew members can order graywater from environmental engineering for watering personal plants. Although a small savings, relatively speaking, using graywater means that much less water to process and less botanical nutrient suspension to synthesize for the plants.

Solid Waste Recycling

Solid waste is separated into three categories: mechanically/chemically recyclable (MCR), matter replicator recyclable (MRR), and hazardous waste. MCR waste will be either sterilized and re-used or mechanically or chemically recycled as this is far less energy intensive than using replicators in the process. Unfortunately, a relatively low percentage of waste is in MCR form.

Matter Replication Recycling

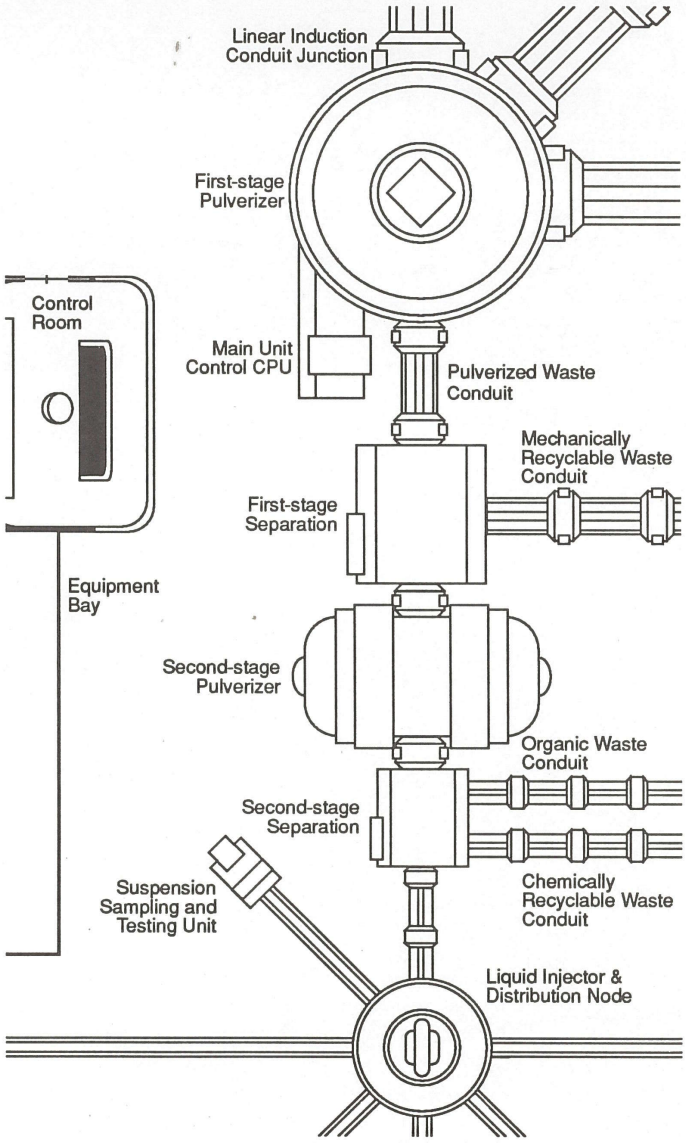
MRR waste is stored as raw material for matter replicators and thus is eventually recycled by use in matter replication. This storage can consume large amounts of space based on the size of the waste and the amount of replicator usage. The *Khai Tam* uses Klingon technology in this area to reduce the storage problems.

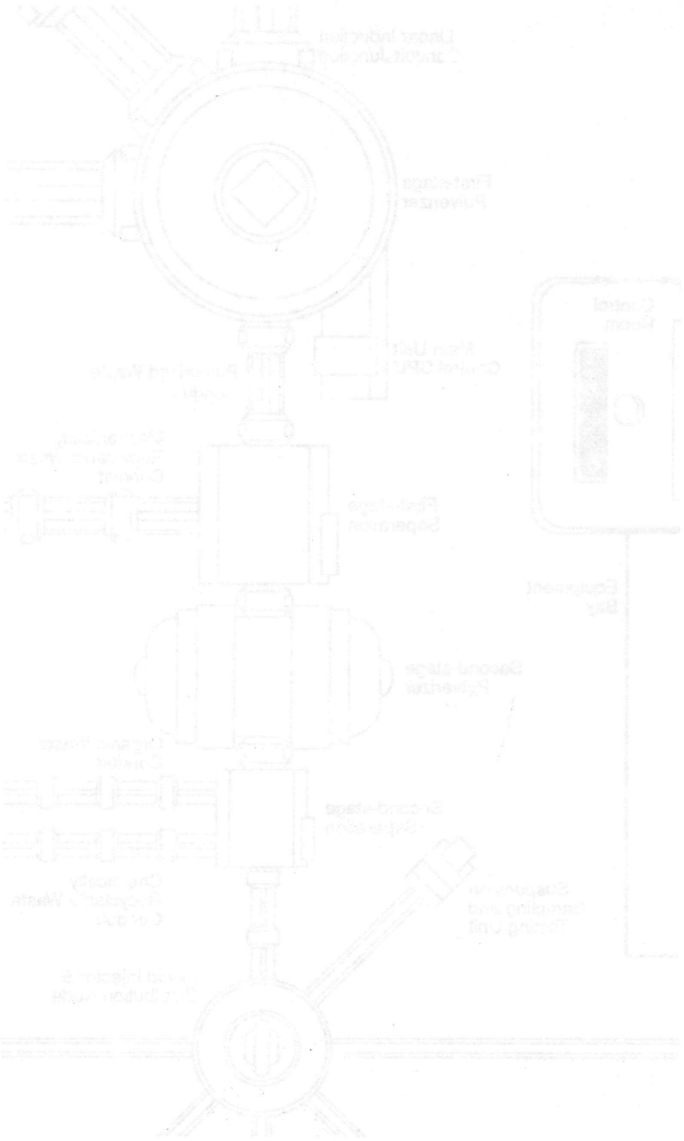
The waste is mechanically shredded into fine particulate matter. The particulate can then be sifted for trace amounts of MCR or organic waste. The particulate still remaining is then suspended in a simple-chain inorganic liquid that can be easily used by the replicators. The liquid suspension is more easily moved about the ship and stored in conformal tanks located in the structural ring. When needed, the suspension is used as raw material by the replicators.

Hazardous Waste Recycling

Hazardous waste is a larger problem on the *Khai Tam* than on many starships due to the greater number of weapons on board and their concomitant propulsive and ordnance wastes. In fact, almost 9% of total waste aboard the *Khai Tam* is classified as potentially hazardous (the figure is only 5% on most vessels). Therefore, handling of the waste is a high priority. This waste is immediately sent to replicators which convert the material into inert carbon particles which are then stored as replicator raw material. The Klingon replication process for hazardous waste recycling is 25% more efficient than its Federation counterpart, resulting in shorter turnaround time and less potential crew exposure to the hazardous material.

Below: The Klingon-designed MRR waste processor (one of four aboard). After sifting for MCR and organic waste, the remaining particulate is suspended in liquid by the distribution node and pumped to storage tanks.





14
Crew Support Systems

It is in the area of crew support and habitability that the *Khai Tam* varies most from its Klingon-variant sister ships. The *Khai Tam* maintains the high standards of human resource management, crew support, and ship habitability found on most Starfleet vessels. And while many technological advancements were incorporated into the *Khai Tam*, so too were many innovative management, training and support strategies and philosophies.

Medical Systems

Medical care is probably the most significant support function on any starship, but even more so for a highly defensive vessel. The ability to care for crew members suffering from a wide range of ailments and injuries aboard ship means less starbase downtime and better crew motivation. And in a combat situation, the ability to deal with casualties effectively cannot be over-estimated.

Outside of a hospital ship, the medical systems on the *Khai Tam* are the most sophisticated aboard any vessel known. The Sickbay Complex incorporates the most advanced equipment and design in the Federation. In fact, this next generation complex was slated for the first *Galaxy* class refit, but was ready in time for the *Qapla'* class. Some minor modifications were made to incorporate Klingon technology, but most systems are Federation original. By their own admission, Klingons do not value medicine as highly as the Federation does so most of the sickbay complex design on the *Qapla'* class was left to Federation engineers.

Facilities

The Medical Department, under the direction of the Chief Medical Officer (CMO), is principally located in the Sickbay Complex in the center of Deck 9. This makes it one of the best-protected areas of the ship, and one of the most stable during IDF failure. More than just a traditional sickbay, the Sickbay Complex houses a wide range of medical facilities in three concentric rings radiating from the center of the deck out to the primary computer cores.

The complex's center houses permanent emergency medical facilities (equipment for temporary emergency medical facilities is stored in all cargo and shuttle bays). This includes two Operating Room/Intensive Care Units (OR/ICU). The OR/ICUs can be completely isolated from the rest of the ship, and their atmosphere and gravity are adjustable for all known sentient life-forms.

The Critical Care Unit (CCU) — what most people think of as "sickbay" — is also located in the core as well as the ship's pharmacy and a small equipment storage area. Of particular interest is the complex's own transporter, dedicated exclusively for medical use. The entire core, along with select labs and offices in the inner ring, are sealed off with automatic doors

which are programmed to open only for personnel wearing properly coded combadges (medical and command personnel).

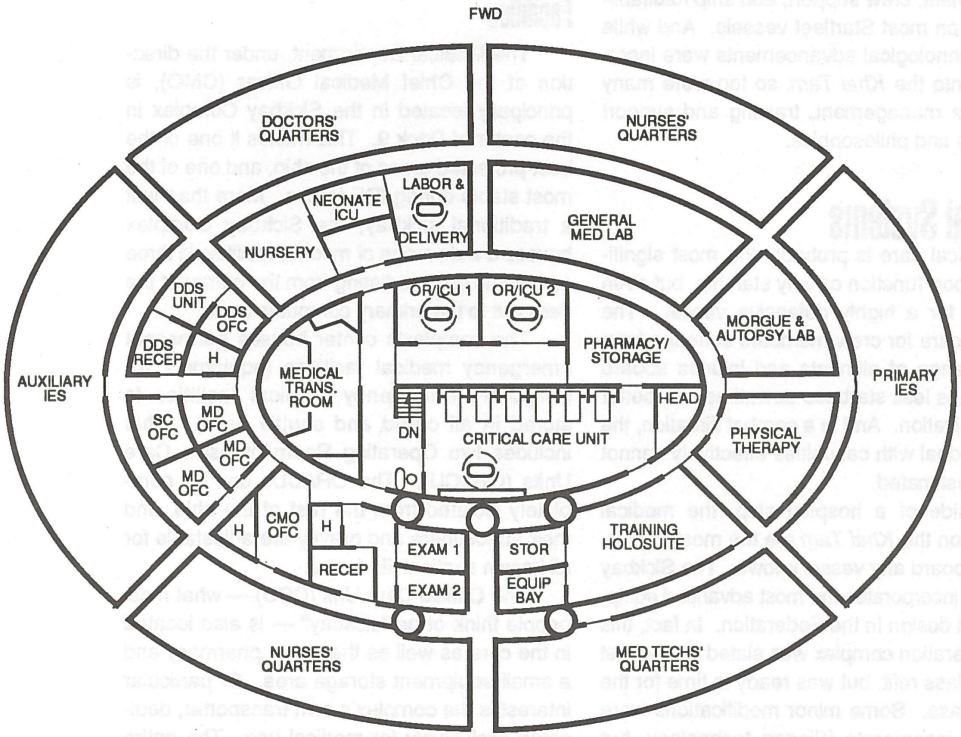
The inner ring of the complex houses secondary medical facilities in a series of suites and labs. Clockwise from port turbolift: The clinic suite containing doctor's, CMO's and ship's counsellor's offices, private examination rooms and a reception area; the dental suite which houses its own reception area, the dental unit, and the dentist's office; a maternity/pediatrics suite containing a variable gravity/environment labor & delivery room, a neonatal intensive care unit, and a nursery (not installed in Klingon-variants); the general medical and autopsy labs and morgue; a variable gravity physical therapy suite; and a dedicated holosuite which can be configured for training and/or conferences. The training holosuite gives the staff an opportunity to train on the most realistic simulations possible which keeps the medical crew of the *Khai Tam* in a state of unsurpassed readiness.

The outer ring of the facility houses living quarters for almost all full-time medical personnel. This keeps travel time to a minimum for emergencies as well as making it convenient for regular work shifts.

Also in the outer ring are two completely redundant IES units (see Chapter 8). When the ship goes to red alert, all sickbay complex systems switch to the IES. This prevents interruption of medical systems if the ship's systems are damaged. This also frees more of the ship's systems to be allocated to defense, propulsion, etc. Using both IESs, the Sickbay Complex can run independently of the ship's systems for nearly 100 hours.

Immediately below the Sickbay Complex on deck 10 is the science lab complex, which may be called upon to assist in any research or analyses needed (see Chapter 12). A ladderway from the core of the Sickbay Complex to the biology lab facilitates personnel traffic and eliminates the need to wait for a turbolift.

Below: The Sickbay Complex. This plan represents the deck layout just inside the two computer cores. In the next ring out you would find the remainder of the medical staff's quarters.



Staff

The medical staff is broken down into three shifts. Each shift is staffed with:

One staff physician. The "duty MD", as they are referred to, is in charge of all patients and patient care during his/her shift. Each staff MD on the ship has at least one sub-specialty. On *Khai Tam*, one doctor sub-specializes in Emergency Medicine and Orthopedic/Vascular Surgery; one in OB/GYN, Prosthetics and Reconstructive Surgery; one in Neurology and Neurosurgery; and one in Cardiology and Thoracic Surgery.

NOTE: There are three doctors on staff besides the CMO...the CMO is almost never the duty MD. This leaves the CMO free to tend to the myriad duties of running the department.

Two duty nurses. One nurse continually monitors all patients from the duty desk located in CCU while the other assists the duty MD. The Head Nurse is typically the assisting nurse on 1st shift. An additional nurse may be posted on each shift to the nursery/neonatal ICU if there are any infants in care.

Three medical technicians. Med techs assist nurses and doctors. They respond to minor medical emergencies and perform other duties as required. One med tech staffs the reception desk in the clinic suite at all times.

One laboratory technician. Lab techs staff the general medical laboratory and run most routine lab work themselves. They assist nurses and/or doctors as needed for more complex lab work.

One engineering liaison. This is an Engineering officer attached to Medical. He/she will operate the medical transporter and perform all routine maintenance and diagnostics on Sickbay equipment. They have a desk in the medical transporter room.

Since first shift is when most routine cases are seen and most administrative business conducted, additional staff is posted during the "day watch" as follows:

Chief Medical Officer. The CMO will typically report for duty to the 1st shift, although they may "check-in" anytime.

Ship's Counsellor. The counsellor's office hours will usually be during 1st shift, although they will be "on-call", or may be seen by appointment, on 2nd & 3rd shifts.

Ship's Dentist. See "Ship's Counsellor".

Two dental technicians. This is a subspecialty of med tech. One usually staffs the DDS reception area while the other assists the Ship's Dentist.

One scrub nurse. A nurse who specializes in assisting surgeries and serving as anesthesiologist. When no surgeries are scheduled, they assist in sickbay as needed and coordinate medical staff training programs.

One pharmacist. This is a nursing subspecialty. The pharmacist synthesizes and/or replicates needed medications and maintains inventory control over stored medications. The pharmacist also serves as the Sickbay Complex logistics officer, coordinating all supplies for the unit and seeing that emergency medical shelters (cargo & shuttle bays) have necessary emergency supplies.

One physical therapist. This is a subspecialty of med tech. When no patients require PT, this med tech assists as needed and coordinates med tech training programs.

One laboratory technician. Additional staff in medical lab to assist with higher 1st-shift workload.

Two medical technicians. Additional staff in sickbay to assist with higher 1st-shift workload.

Training

Starfleet personnel are some of the most well-trained space farers in the known galaxy. That high level of education and readiness is maintained aboard *Khai Tam*. Personnel are constantly drilled in the fundamentals of their jobs as well as educated in the latest developments in their fields. Opportunities for advancement and lateral transfer are fostered through a program of next-level training and cross-training in other fields. In fact, a typical *Khai Tam* crew member can usually perform at least one and usually two other jobs apart from their primary specialty (more than 20% of the crew is cross-trained in emergency medicine).

The "hardware" of training on *Khai Tam* includes classrooms as well as a new development: a sophisticated series of small holosuites dedicated to training programs which can provide realistic simulations in almost any field. No longer will training programs have to share holodeck time with recreation programs (the training holosuites do, by happy coincidence, free up the holodecks for more recreational use).

The "software" of training includes professional development programs, visiting lecture series, ongoing focus groups, on-the-job training, and a variety of innovative and dynamic programs offered by the training department. Everything from "Small Arms Tactics" to "Psychology of Military Leadership" is offered through interactive simulators and classrooms aboard the *Khai Tam*. In fact, motivated crew members can earn academy credits and even entire degrees while serving aboard.

On most Starfleet ships, the duty of Training Officer is placed on one of the officers as a secondary function. On the *Khai Tam*, however, there is an entire Training Department staffed with administrators, facilitators and instructors—many of whom are civilian family members of *Khai Tam* crew.

Below: The crew billet portion of a new crew member's boarding orders (usually given/read via PADD) tells the crew member to which cabin they have been assigned and how to get to it. Further information can be called up on the PADD.

Habitability

The creation of a Ship's Habitability Department is another of the innovative human resource management programs aboard the *Khai Tam*. The Habitability Department oversees crew quarters systems, food replication systems, and most crew recreation programs.

CREW BILLET

Welcome aboard the USS Khai Tam, Ensign Kyvn Tai

You have been assigned to cabin 09-1417

Cabin 09-1417 is a single Class M stateroom.

To get to your cabin, enter any turbolift and state, "Deck 9, Junior Officer's Quarters". Exit turbolift and turn right at first corridor junction. Your cabin will be the third door on the right.

Crew Quarters Systems

Crew Quarters on board the *Khai Tam* are very similar to those found on *Galaxy* and *Nebula* class ships. In fact, the habitation modules for most of the *Khai Tam's* primary hull are identical in basic design to those used on the *Galaxy*. *Qapla'* and *Targ* offer rather spartan accommodations as is typical in Klingon design, but *Khai Tam* (and *Relentless*) offers comfortable staterooms, well appointed public spaces, and an attractive overall appearance.

Each crew member is assigned an average of 100 square meters of personal living spaces (a little less for enlisted personnel, a little more for senior officers). These accommodations typically include a bedroom, living/work area and a bathroom. Each stateroom is equipped with a food replicator terminal, sonic and standard showers, and a limited computer interface terminal. Some two-bedroom staterooms are available on Deck 13 for families living on board. Family space is limited and is filled on the basis of rank and time aboard.

The Captain has two staterooms after the Old Earth naval custom. His "in-port" stateroom is located near the forward gangway hatch on Deck 12 and is spacious and well appointed with personal amenities. This is the stateroom the Captain uses to host guests while in port, and while underway it is often used as VIP quarters or as a small diplomatic conference area. The Captain's "underway" stateroom is a standard senior officer stateroom located on Deck 8, just forward of CIC. The Captain's, First Officer's, and Second Officer's staterooms all have a dedicated computer display which constantly shows the ship's present position, course, speed, and alert status.

A large block of stateroom space on Deck 9 has been reconfigured and held aside for use in troop transport or casualty evacuation. Each room houses five racks of four bunks each for a total of 400 extra beds. The rooms are quite crowded when full, but are usually used only for short periods. When not in use, the bunks can be folded into the racks to increase floor space. When a "bunk room" is not occupied it is often used to store cargo, using bunks as shelves or folded bunks as tie-up racks.

Any crew member assigned to the *Khai Tam* for more than six months may reconfigure their quarters within certain mass and volume limits. Many of the Klingon exchange crew have taken advantage of this to configure their quarters in the traditional Klingon manner.

Approximately 25% of the staterooms aboard the *Khai Tam* can be reconfigured to Class H, K, or L environmental conditions. An additional 5% can be adapted to Class N or N(2) conditions (see Chapter 13). This is the largest ready-conversion ratio of any Starfleet starship, and has led to one of the most diverse crew assignments in Starfleet.

Dining Facilities

Even though everyone has the ability to replicate their own meal in their own cabin, that can get boring on a year-long cruise. Therefore, *Khai Tam* has five public dining areas for the crew. Those desiring table service and/or a more social dining experience can visit these dining facilities:

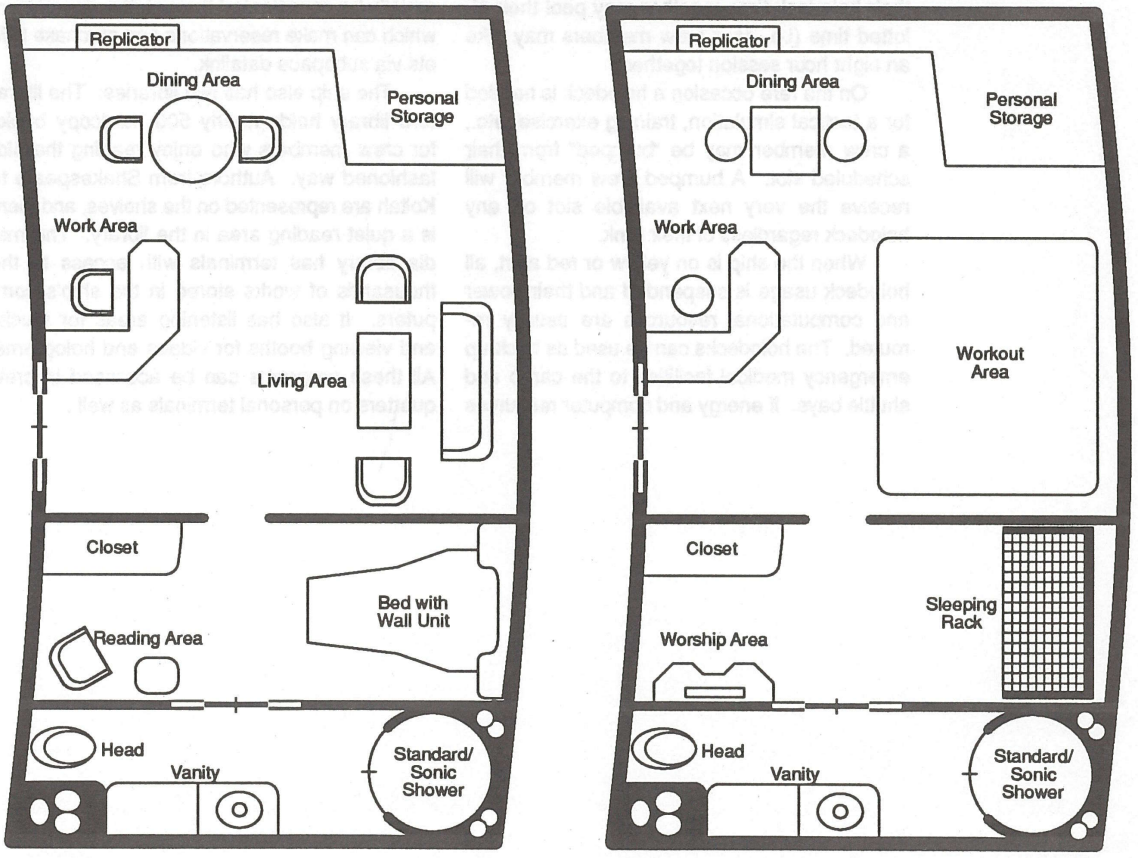
The Wardroom: This facility is a table-service dining room for officers and their families/guests.

The Pig & Whistle: This is a self-service replimat for enlisted personnel and their families/guests.

La Nuit d' Étoile (The Starry Night): This is an intimate table-service dining room open to all crew and visitors. The smallest of the public dining rooms, reservations are sometimes required.

Downtime: The ship's lounge—open to all crew members and visitors.

Soj Suvwl'Daj (Food of the Warrior): A self-service replimat specializing in Klingon fare—open to all crew and visitors.



Below: These two cabins are both standard junior officer's quarters. The difference is the occupants. The cabin on the left is occupied by a human who has configured the room for his comfort and enjoyment. The cabin on the right has been configured by its Klingon occupant to meet her requirements.

Crew Recreation Programs

Simply accommodating the recreational needs of some 200 Klingon crew members is enough of a challenge, but the Habitability Department endeavors to keep the entire crew challenged and/or relaxed with their many recreational programs.

The most popular among the department's programs is holodeck usage, of which the average crew member will get 2 to 4 hours a week. The *Khai Tam* has four large holodecks (1 through 4) and eight smaller ones (5 through 12) not including myriad training holosuites. The department schedules holodecks 1, 2, 3, 5, 6, 7, and 8 for enlisted personnel on a first-come-first-served basis with a 2-hour, once-a-week maximum (unless there is surplus time at the end of the week). Holodecks 4, 9, 10, and 11 are reserved for officers. Holodeck 12 is reserved for senior officers and crew members requiring Class H, K, L, N, or N(2) conditions (it has an airlock entrance and special environmental hook-ups). Personnel who wish to take their holodeck time together may pool their allotted time (i.e.- four crew members may take an eight hour session together).

On the rare occasion a holodeck is needed for a tactical simulation, training exercise, etc., a crew member may be "bumped" from their scheduled slot. A bumped crew member will receive the very next available slot on any holodeck regardless of their rank.

When the ship is on yellow or red alert, all holodeck usage is suspended and their power and computational resources are usually rerouted. The holodecks can be used as back-up emergency medical facilities to the cargo and shuttle bays. If energy and computer resources allow, the holodecks can be converted to emergency accommodations for casualty evacuation. While Klingons have been long known to scowl upon the creature comforts of Federation ships, it is interesting to note that the Klingon-variant ships are fully equipped with holodecks, and that usage on both variants are comparable.

Other Recreation. The Habitability Department also schedules and supervises programs on board in the performing arts (usually held in the ship's auditorium or in the ship's lounge), in the physical arts (in the ship's gymnasium or in holodecks), and in many culturally unique recreational activities. They also hold regular classes in art, music, theatre, and crafts. Crew members who have expertise in a particular hobby often volunteer to hold classes for the rest of the crew.

When a stop is going to be made at a starbase or planet, the Habitability Department will send ahead for a list of activities and places to visit available at the port. This list will then be published in the ship's electronic newsletter. Any activities requiring advanced scheduling will usually be coordinated through the department which can make reservations and purchase tickets via subspace datalink.

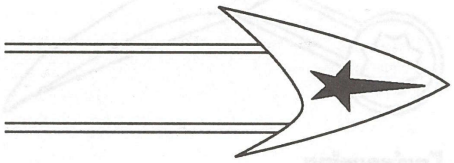
The ship also has two libraries. The literature library holds nearly 500 hardcopy books for crew members who enjoy reading the old-fashioned way. Authors from Shakespeare to Koltah are represented on the shelves, and there is a quiet reading area in the library. The media library has terminals with access to the thousands of works stored in the ship's computers. It also has listening areas for music, and viewing booths for videos and holograms. All these programs can be accessed in crew quarters on personal terminals as well .

15
Personnel Resources

The Klingons and Federation have both maintained for decades that their most valuable resource is their people. Without highly trained and motivated crews, billions of credits of hardware across the galaxy would be worthless. The job of keeping crews trained and motivated falls to Crew Support Systems (see chapter 13), the job of keeping them organized and working falls to Personnel Resources.

The staffing and organization of each department is carefully coordinated through Personnel Resources which in turn maintains crew assignments and all personnel records. Personnel Resources assures that all departments maintain adequate staffing levels and that all personnel are periodically and fairly evaluated. They also administer pay and promotions for all crew members. Last, but certainly not least, Personnel Resources acts as ombudsman in settling disputes between crew members and their associates or superiors when normal channels are inappropriate.

Each department is headed by a Department Chief (DC) responsible for all operations in that area. The DC may in turn subdivide their department and delegate authority over certain groups or activities. The staffing of departments and their organization is covered under the subsections below. Along with each department note their logo. These logos are designed and/or agreed upon by the members of each department and may or may not be unique specifically to the *Khai Tam*.



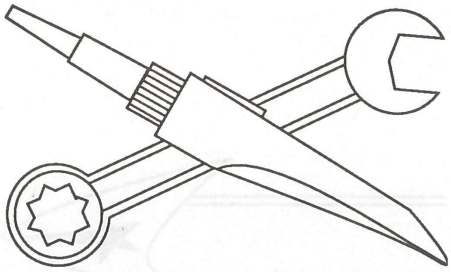
Command

The Command Department of the *Khai Tam* is by far the smallest of the departments. It's only actual members are the Captain and First Officer, the ship's Navigation Officer, a small contingent of Flight Controllers and the Personnel Resources Division. All other officers in the chain of command are assigned to other departments. Interestingly, the DC of Command is actually the First Officer. The Captain has the larger responsibilities of the ship and does not have the time to administer the department.

The navigation of a vessel has been the primary responsibility of a ship's commander for centuries. Even today, the loss of a ship in battle is still not looked upon as harshly as a navigational error. A collision with another ship or other object is still grounds enough to relieve a Captain of command. Therefore, navigation and helm responsibilities still reside in the Command Department.

The ship's Navigation Officer oversees the complement of Flight Controllers. Any officer with the Captaincy as a career goal usually starts their career as a Flight Controller. A combination helmsman and navigator, the Flight

Controller (or Conn Officer as they are often called) is the individual who actually plots the course and implements maneuvers of the ship. Flight Controllers typically serve a year or two in the command department learning the intricacies of stellar navigation and taking courses in the even subtler intricacies of commanding people. They also stand watches as OD to gain experience in command. After their tour in Command, the officer is typically assigned a low-level command slot in a department their education and experience suit them for.



Engineering

The Engineering Department is the largest single department on the ship, and with good reason: it is charged with maintaining almost all the hardware aboard the ship. From the warp drive to the food replicators, Engineering's job is to keep it running at optimal efficiency. Due to the wide range of systems it must maintain, the Engineering Department maintains several sections and subsections under the direction of its DC, the Chief Engineer.

Warp Propulsion

Responsible for all aspects of the operation and maintenance of the warp drive from matter & antimatter storage to the warp core, to the engines themselves. The WPS Officer is second-in-command of the department.

Impulse Propulsion

Covers everything having to do with the IPS from fuel storage to vectored thrust manipulation. They are also responsible for the ship's reaction control system. The IPS Officer is Engineering's third-in-command.

Power Distribution

The Power Distribution officer ensures that energetic plasma is siphoned from the warp core and routed to those systems that require it. They are also responsible for energy conversions and for getting that converted energy (i.e. - plain old electricity) to the rest of the ship. They are also responsible for the maintenance of waveguides and wiring throughout the ship.

Structural Integrity/Damage Control

Physical hull integrity, spaceframe maintenance, Structural Integrity and Inertial Dampening Fields are all the responsibility this section. Damage Control, however, is its most demanding role and drills and training are constantly taking place in this area. More crew members are cross-trained in damage control than in emergency medicine, and this department trains and drills these cross-trained personnel as well as its permanent staff.

Environmental Engineering

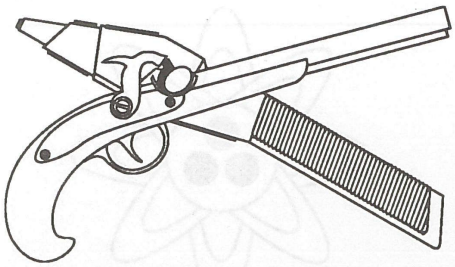
If the gravity is out, call Environmental Engineering. They are responsible for all Life Support and Environmental systems as well as the maintenance of crews quarters, replicators, plumbing, turbolifts, and just about anything else having to do with crew support.

Transporter Systems

Maintenance and operation of the transporters is the responsibility of this small but highly specialized section. Anyone hoping to earn a transporter operator's certificate must spend at least six months in this department.

Auxiliary Engineering

The catch-all for the myriad little jobs that none of the recruiting holos talk about. This is the section that most Engineering Liaisons are assigned to. Engineering Liaisons are personnel who officially report to Engineering, but their actual duties are in another department. For example, the Medical Department has an Engineering Liaison on duty at all times to maintain its vital systems and to operate its transporter.



Security

The Security Chief is the DC of Security. On a ship like *Khai Tam* the security contingent can become quite large. In fact, after Engineering, Security is the largest department aboard and is divided into three sections:

Internal Security

Internal Security is responsible for the safety and security of all personnel aboard, whether Starfleet personnel or not. They process security clearances, investigate possible compromises, perform training, form honor guard details, respond to intruder alerts, perform criminal investigations and operate the brig.

They also secure classified data, maintain intruder deterrent systems, monitor the combadge security system and transporter weapons detectors, operate small arms lockers and armories, construct special barricades or monitors, and control and distribute safe, door, and forcefield combinations and clearances.

On a ship with no Marine Detachment, Personnel Security would also stand guard as sentries in the ship's restricted areas and serve as protective escort for the command staff and VIPs aboard; however on *Khai Tam* those jobs are handled by the Marines (see below).

Tactical Systems

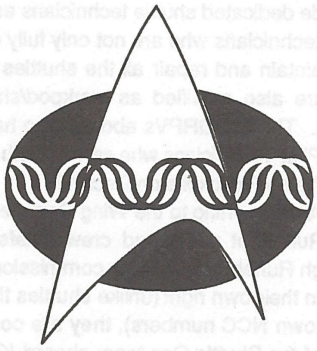
Tactical Systems is responsible for tactical and strategic intelligence, weapons readiness and operation, and the operation of the ship's Combat Information Center (CIC). It is the largest of the security subsections, and arguably the most boisterous. Much of the Klingon exchange crew is assigned to Tactical Systems.

Tactical Systems personnel operate and maintain all ship's weapons including phasers, torpedoes, and disruptors. All tactical sensors, fire control systems, and intelligence gathering and interpretation are also the purview of Tactical Systems. The squadron of GT1 shuttles reports to this division.

Marine Detachment

The other major subsection of Security is the Marine Detachment. Marines stand watch as sentries in the ship's restricted areas as well as provide a protective escort for the ship's command staff. They are also responsible for security presence on away missions, boarding parties and assault groups.

The 78th Marine Strike Group is assigned to the Security Department of the *USS Khai Tam*. It is considered a Company in strength: three platoons of three squads each (60 marines total). Each squad contains a squad leader, three light weapons specialists, one heavy weapons specialists, and one combat corpsman. During cruise mode, one platoon is on per shift with one squad divided up as security escorts and two squads divided up as sentries. There are also two shuttle pilots trained in covert insertion/extraction who fly and maintain the MSG's two Type 7L shuttles.



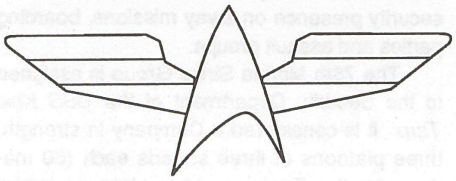
Communications

The responsibility of operating all ship's communications falls on the ship's Communications Officer (the Department Chief), while the maintenance of the systems is shared with Auxiliary Engineering. The communications department is divided into internal and external sections similar to the Security Department.

The Internal Communications Section maintains and operates the ship's intercom and

combadge systems, publishes the ship's electronic newsletter, maintains the suggestion and messaging systems, and produces training and informational tapes and holograms.

The External Section handles subspace and RF radios, digitized laser signals and encrypted communications and data links (see chapter 8).

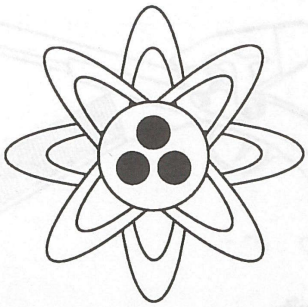


Shuttle Ops

Because of the large number of shuttlecraft, pilots and maintenance personnel aboard, the *Khai Tam* has her own Shuttle Ops department (she and *Relentless* are the only non-shuttle-carriers in the fleet to have one). Traffic controllers, FDOs, pilots and crew chiefs are all supervised by Shuttle Ops' DC, the Shuttle Wing Commander.

The maintenance personnel in Shuttle Ops include dedicated shuttle technicians as well as pilot-technicians who are not only fully qualified to maintain and repair all the shuttles aboard, but are also qualified as workpod/shuttlepod pilots. The ten QRPVs aboard also have their own Pilot-Technicians who service both the craft and their VR cockpits on Deck 17.

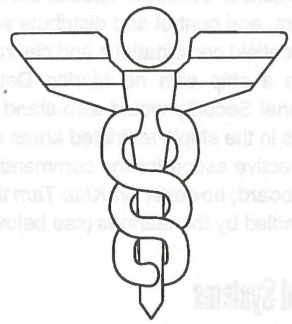
Also reporting to the Wing Commander are the Runabout pilots and crew chiefs. Even though Runabouts are fully commissioned vessels in their own right (unlike shuttles they have their own NCC numbers), they are considered part of the Shuttle Ops team aboard *Khai Tam*. The two Runabouts attached to *Khai Tam* are the *Kaskaskia* (NCC-71992) and the *Santa Ana* (NCC-71982).



Science

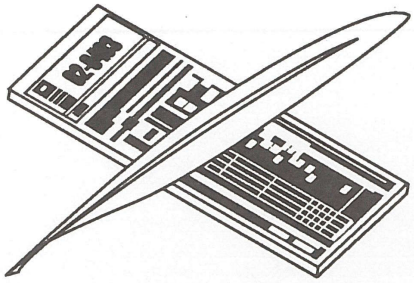
The ship's Science Officer coordinates the several physics labs aboard as well as planetary meteorology, archeology/anthropology, geology, planetary and stellar cartography, and other physical science labs in the Science complex on Deck 10. Life science activities are a joint responsibility of the Science Officer and CMO (see below and Chapter 12).

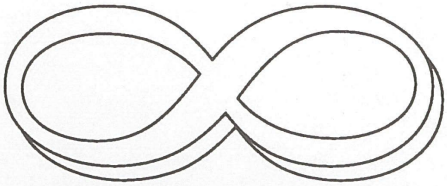
In addition to her primary missions, the *Khai Tam* is usually involved in several simultaneous secondary missions, most of which are the responsibility of the Science department. They are also responsible for supervising civilian and temporary science teams that may be on board.



Medical

For a complete breakdown of Sickbay Complex staffing, see the "Medical Systems" section of Chapter 14. The Chief Medical Officer also has joint responsibility with the Science Officer over the several biology, zoology and botany facilities in the Science Complex on deck 10.





Ops

Coordinating the resources of a ship like the *Khai Tam* is no small job, and that job falls to the Operations Department or "Ops" for short.

Ops personnel are typically generalists who have served in a variety of jobs in their Starfleet career with the goal of knowing each well enough to oversee the operation and resource allocation of several departments simultaneously. The Operations Manager is the DC of Ops and Second Officer of the ship, and is responsible for allocating resources like computer and sensor time, power, water, etc. to the various departments.

While the Captain may always have detailed knowledge of his ship's navigation and readiness state at all times, the Ops Manager is probably the one person on the ship who knows the most about what is going on in every department at any given time.

Ops also has the responsibility for operation and maintenance of the ship's computer system. They maintain and operate both main cores as well as servicing subprocessors and terminals along with Auxiliary Engineering.

Auxiliary Services

Without a doubt the most diverse department aboard any ship is Auxiliary Services. If a job doesn't belong to one of the above departments, it belongs to "Aux". This includes everything from the Ship's Habitability section (see Chapter 14), to the Ship's Continuing Education Program.

Aux personnel run the lounge, the restaurants, the laundry, the barber shop, the ship's store, the school, the libraries, the gymnasium, the holodecks, etc. Most everything that keeps the crew happy and productive is handled by this department. For a complete description of all the services offered by the Aux department, consult the shipboard publication, "Your Guide to Auxiliary Services".

Aux is also the only department authorized to hire civilians on a regular basis and attempts to employ as many on-board family members (spouses and older children) as possible. This is often a crucial factor in a family's satisfaction during a cruise—and therefore can greatly affect the motivation and performance of the crew member in question.

16
Flight Operations

Flight Operations are those protocols established for the ship to function efficiently on a daily basis. It would seem that the importance of such a subject would earn this chapter an earlier placement in this manual—but it is impossible to accurately envision how Flight Ops works until a basic understanding of the entire vessel is gained. Therefore this chapter is placed last to give the reader the "big picture".

Since *Khai Tam* is a weapons-heavy platform and is periodically used as a sector defense ship, her flight operations differ from most Starfleet vessels. One area where operations differ is in command, control, and communication (C^3) procedure.

For example, the officer responsible for navigation of the ship is said to "have the conn" (this is different from the Conn position on the bridge—the officer with the conn is not the Flight Controller, but the person giving navigation orders to the Flight Controller). The officer responsible for primary mission execution is said to "have the deck" and is designated as the Officer of the Deck (OD). Usually the OD has both the Deck and the Conn, but not always. If the Captain is directing an attack from the Combat Information Center (CIC) for example, he may take the Conn, but not the Deck.

Communications are similarly defined. If the CIC Tactical Sensor position (TacSens) should encounter a contact on a defensive patrol, the following exchange would be typical of *Khai Tam* communications:

TacSens: "Conn, Sensors—I have a new contact bearing 240 mark 3. Designate contact Papa 1." *The bearing is relative to the ship, Papa means the contact was first acquired using passive sensors (Papa refers to "P" for passive sensors).*

Conn: "Sensors, Conn, aye—Establish TMA and attempt to ID. Security, Conn—Bring the ship to yellow alert, quick quiet." *"TMA' refers to Target Motion Analysis. See below for more on the terms "yellow alert" and "quick quiet".*

Although these procedures are more formal than on most ships, there is good reason. Confusion or miscommunication in a battle situation can be disastrous, and the *Khai Tam* is often used as a defensive power. Therefore, nothing is left to chance when it comes to who is in charge of what, and who is saying what to whom.

Mission Types

The *Khai Tam* is capable of carrying out a variety of missions, albeit many of them defensive in nature. Most starships have one category of primary mission types called "Tactical and Defense" whereas the *Khai Tam's* mission profiles expand on the term immensely. By and large *Khai Tam's* missions fall into one of several standard categories.

Preliminary Survey

Here the ship is assigned to survey a planet, star system, or general area of space. Usually such missions involve charting, compositional analysis, and cultural analysis if the subject is an inhabited planet or system. If these initial studies warrant further research, the *Khai Tam* can mark position and call for a science vessel to be dispatched.

First Contact

In the remote areas she patrols, the *Khai Tam* is sometimes called on to make first contact with a society on behalf of the Federation. Her defensive capabilities assure, however, that the Federation is well represented if the new beings aren't interested in talking (like the Borg).

Defensive Patrol

In a sector where open hostilities have not been declared, but where a defensive presence is required, the *Khai Tam* may be assigned a defensive patrol. Here, the main goal is to project force, and to be ready to respond authoritatively if hostilities break out.

Combat Patrol

Combat Patrols are patrols carried out during open hostilities when the use of force has been authorized. Here, the *Khai Tam* would be assigned a sector of space to patrol, having full authority to challenge and engage any hostile craft entering or approaching the zone.

Special Operations

Missions involving intelligence gathering or covert activities are known as special operations. On a special ops mission, the *Khai Tam* may be sent to covertly gather signal intelligence in a border area, to support an intelligence vessel with defensive cover, or to covertly insert or extract a special ops team on a planet.

Emergency and Rescue

Although she doesn't have the facilities for evacuation on a colonial scale, her speed often makes the *Khai Tam* the first ship on the scene in emergency situations.

Operating Modes

The *Khai Tam* conducts its operations under an established set of protocols based on the operating mode or readiness level of the ship. Although she has similar operating modes to the rest of the fleet, her defensive role usually requires a higher readiness level for any given alert status. For example, while on most ships Yellow Alert means the next shift is alerted to be ready for duty, on the *Khai Tam* it means the next shift reports to their alert duty stations.

Cruise Mode

Cruise Mode is the normal operating condition of the spacecraft. In Cruise Mode, only one of the three eight-hour shifts is on duty. The first shift or day watch is when the bulk of the ship's business is accomplished and it is the shift most populated. Departments which accomplish tasks that are not required 24 hours a day usually assign them to the day watch. The second shift or mid watch is the second most populated. This is the shift during which most first and third shift personnel socialize, so the Auxiliary Services Department is well staffed during this shift. The third shift or night watch is the least populated, consisting only of those crew members needed for 24-hour operations or combat readiness. Operational rules for Cruise Mode include:

- **Propulsion/Power:** One major power system (WPS, IPS or standby fusion generators) must be available at all times, one on standby.
- **IWS:** One phaser emitter and one disruptor must be operational. One forward and one aft torpedo tube must be loaded with a Type 1 torpedo armed and ready. At least one deflector shield must be operating at no less than 20% output, with 100% capability.
- **Auxiliary craft:** One Runabout, one QRPV1, one QRPV2 and one GT1 must be on ready-alert (five minute launch readiness) at all times. A personnel shuttle must be on 30-minute alert. The Main Shuttlebay is usually in constant operational readiness under cruise mode.

- **Sensors:** One suite of long range navigational and passive tactical sensors must be operational at all times. At least one suite of tactical active sensors on hot standby.
- **C³:** OD on Main Bridge has the deck and conn. CIC monitors navigation, readiness and alert status and processes incoming intelligence. The Signal Officer may usually approve outgoing transmissions.

Yellow Alert

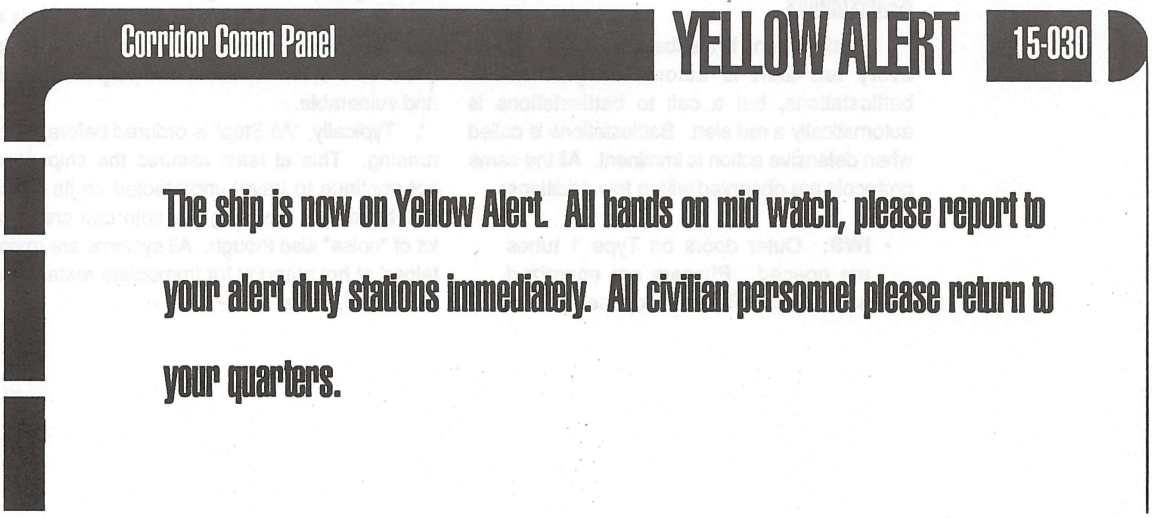
Yellow Alert indicates that a situation requires an increased state of readiness. Immediately upon sounding Yellow Alert, the next shift due to come on is alerted to report to alert duty stations (i.e. - if the mid watch is on duty, the night shift will go to alert stations). Operational rules for Yellow Alert include:

- **Propulsion/Power:** While power may be drawn from only one system, all three major systems must be made available for immediate use.
- **IWS:** All phasers and disruptors must be made operational. Four forward and four aft tubes must be loaded with at least a Type 1 torpedo (other ordnance may be ordered). The remaining tubes are held open in case the situation requires a unique weapons load. At least one shield must be operating at 100%, with the other shield on hot standby.
- **Auxiliary craft:** One Runabout, two GT1s, and all QRPVs must be on ready-alert. A personnel shuttle must be on 30-minute alert. Both shuttlebays must be made operational.
- **Sensors:** All passive sensors must be made operational. All tactical active sensors on hot standby. Active sensors are used with OD's/Captain's authorization only as they can reveal the ship's position.
- **C³:** OD on Main Bridge will usually retain deck and conn, the Captain may be called to bridge or CIC. CIC is fully staffed and commences tactical analysis, continues to monitor navigation, readiness and alert status and process incoming intelligence. The OD must authorize any outgoing transmissions.

Red Alert

Red Alert indicates an emergency situation. Immediately upon sounding Red Alert, all hands report to their alert duty stations. Key personnel report to their primary work areas

Below: When the ship is on any type of alert status, corridor Comm Panels and other select terminals will display a message like this one. Depending on the situation and alert-level, civilians may be directed to their quarters, emergency shelter areas, or to the separable hull for possible hull separation.



while cross-trained personnel previously off duty report to their secondary duty stations. Unlike other ships which give their third shift 15 minutes to report to stations, all hands on the *Khai Tam* are expected to be at their alert duty stations within three minutes (manner of dress and personal hygiene not withstanding). Operational rules for Red Alert include:

- **Propulsion/Power:** All systems at full readiness with WPS and IPS running with at least 75% power output.
- **IWS:** All weapons must be ready. The torpedo load remains the same with weapons receiving target data every millisecond. The remaining tubes may be loaded at any time. Both deflector shields must be running at 100%.
- **Auxiliary craft:** One Runabout, one personnel shuttle and all GT1s/QRPVs must be on ready-alert with snother personnel shuttle on 30-minute alert. Both shuttlebays must be operational.
- **Sensors:** Same as yellow alert.
- **C³:** The Captain will usually take the conn. CIC is fully staffed and continues tactical analysis. Fire control is on full standby in CIC. TMA will be performed and firing solutions calculated for every hostile/unidentified contact.

Battlestations

Battlestations is a subset of Red Alert. Not every red alert is automatically a call to battlestations, but a call to battlestations is automatically a red alert. Battlestations is called when defensive action is imminent. All the same protocols are observed with a few additions:

- **IWS:** Outer doors on Type 1 tubes are opened. Phasers are energized and disruptor PTCs are opened.
- **Auxiliary craft:** Shuttlebay doors are opened if they haven't been already. A QRPV1 and a GT1 are each placed on a pad and powered up.
- **C³:** The Captain will take the conn and transfer command to CIC. The Main Bridge will be staffed with a back-up crew in case hull separation becomes necessary.

Quick Quiet

Quick quiet is an operational mode that can be initiated at any time under any alert status. Its protocols run parallel to, not instead of, those above. A normal operation under one of the above modes would only be prevented if it would violate Quick Quiet.

The most amazing thing about space is how little is actually in it. In the vast distances between the relatively few things in space, it is very difficult to locate a ship unless it is making some kind of "noise" like subspace distortion, radio signals or active sensor sweeps. When Quick Quiet is ordered, all active sensors or outgoing communications are shut down to avoid giving away the ship's position.

Silent Running

When the order is given, "Rig for Silent Running" it means that the tactical situation demands that the ship's position not be given away. Any system that gives off "noise" — including engines, navigational deflectors, and shields—are immediately shut down. This is a very dangerous operating mode for the ship because it is, for all intents and purposes, adrift and vulnerable.

Typically, "All Stop" is ordered before silent running. This at least assures the ship does not continue to travel unprotected on its previous heading. Stopping the ship can create a lot of "noise" also though. All systems are maintained at hot standby for immediate restart at a moment's notice.

Appendix A
Glossary of Terms and Acronyms

A/G: Accelerator/Generator. Part of the IPS.

abaft: To the rear of. For example, the impulse engines are abaft the main bridge.

aft: Toward or at the stern of the ship.

AIE: Auxiliary Impulse Engine. The engines on the separable hull.

amidships: The middle part of the ship, halfway between the bow and the stern.

around: Indicates a feature on a drawing that repeats around the perimeter of a vessel.

beam: The width of the ship at its widest point.

BOL: Bearing-Only Launch. A torpedo launch mode.

bow: The front part of the ship.

Bridge, Main: The control center from which the ship is usually navigated.

bulkheads: Walls that divide decks into compartments.

C^3: Command, Control, Communications.

C: Cruiser.

Capt: Abbreviation for Captain.

CCU: Critical Care Unit. The portion of the Sickbay Complex that most people picture when they think of "sickbay"

Cmdr: Abbreviation for Commander.

centerline: An imaginary plane dividing a vessel in two equal halves longitudinally.

CIC: See Combat Information Center.

civ: Abbreviation for civilian personnel.

CMO: Chief Medical Officer.

CO: Commanding Officer.

Combat Information Center: The control center from which the ship's sensors and weapons are operated. The ship can be navigated from CIC if needed.

CPO: Chief Petty Officer.

CRGP: Catastrophic Resource Contingency Plan. An emergency plan for resource usage.

crypto: Relating to the encryption or decryption of data/messages.

DC: Department Chief.

DCA: Driver Coil Assembly. Part of the IPS.

DDS: Medical degree of dentist.

dock: To actually attach a vessel to another vessel or station at a docking port where crew and cargo can be directly transferred on and off the ship (see "moor").

door: An opening in a deck or bulkhead with a closeable door that is not airtight (see "hatch").

dorsal: The upper surface or "back" of the ship.

draft: The height of the ship from its top-most to bottom-most points.

DT: Data Transmission. A prefix used in message communication.

EASE1: Energy Attractant Static Explosive - 1. A type of mine designed under the *Qapla'* Class Development Project.

EC: Exploratory Cruiser.

EM: Electromagnetic (a type of radiation).

enl: Abbreviation for enlisted personnel.

Ens: Abbreviation for Ensign.

EPS: Electroplasma system. The main power distribution system on most starships.

FDO: Flight Deck Officer.

forward: toward the bow of the ship.

FTL: Faster Than Light.

hardpoints: Specially reinforced exterior sections of a vessel used for connecting umbilicals, gangways, exterior ordnance, etc.

hatch: An opening in a deck or bulkhead with a closeable door that is airtight (see "door").

HC-E: Heavy Cruiser—Exploratory.

HC: Heavy Cruiser.

helm: The operator's console from which the ship is being steered (usually the Flight Controller's console on the Main Bridge).

hold: Synonym for cargo bay. An area where cargo is normally stored.

I/O: Input/Output.

ID: Identification.

IDF: Inertial Dampening Field. The energy field which counteracts the affects of acceleration on a starship.

IES: Independent Emergency Systems. Emergency back-ups of critical resources used in key areas of a vessel.

IGS: Inertial Guidance System. The system which allows a ship to plot its position without external reference points.

IKV: Imperial Klingon Vessel.

Integrated Weapons System: The combined systems of photon torpedoes, mines, phasers, disruptors, and defensive shields.

IPS: Impulse Propulsion System.

IRC: Impulse Reaction Chamber. Part of the IPS.

IWS: See "Integrated Weapons System."

Jeffries Tube: Crawlspaces between decks that house piping, wiring and waveguide conduits.

KCWD: Klingon Council on Warship Design.

keel: See "spaceframe."

ladderway: Vertical accessways between decks containing steps or rungs.

LCARS: Library Computer Access and Retrieval System. The primary user interface of the ship's computer.

Lt jg: Abbreviation for Lieutenant Junior Grade

Lt: Abbreviation for Lieutenant

LtCdr: Abbreviation for Lieutenant Commander

M/ARA: Matter/Antimatter Reaction Assembly. The heart of the WPS.

MCR: Mechanically/Chemically Recyclable. A category of waste.

MD: Medical degree of doctor.

MIE: Main Impulse Engine. The impulse engines on the primary hull.

MITS: Multiple Independently Targeted Submunitions. Torpedo warheads capable of separating from the torpedo and pursuing its own target.

MJL: Micron Junction Link. Computer core components which allow data from the FTL processors to be transferred into the rest of the system.

moor: To keep a ship in position with umbilicals (see "dock").

MRR: Matter Replicator Recyclable. A category of waste.

MSG: Marine Strike Group.

MTB: Main Torpedo Bay.

MUN: Major Utilities Networks.

NCC: Navigational Contact Code/Naval Construction Contract.

OB/GYN: Medical degree of obstetrician/gynecologist

OD: Officer of the Deck. The officer responsible for executing primary mission objectives during a particular watch.

ODN: Optical Data Network.

OR/ICU: Operating Room/Intensive Care Unit.

p/s: Abbrevaition for port and starboard. Indicates a feature on a drawing which is repeated on the other side of the vessel.

PADD: Personal Access Display Device

port: The left side of the ship when facing the bow.

Pri Flight: Primary Flight Control. The center for shuttle operations.

PT: Physical Therapy/Physical Therapist.

PTC: Power Transfer Conduit. The prime component of the EPS.

PUN: Protected Utilities Network.

QRPV: Qapla' Remotely Piloted Vehicle.

RBL: Range-Bearing Launch. A torpedo launch mode.

RCS: Reaction Control System. The system of low power thrusters that steers the ship at sublight speeds.

RF: Radio Frequency.

RN: Medical degree of nurse.

RUN: Reserve Utilities Networks.

RVT: Real-time Voice Transmission. A prefix used in message communications.

SC: Ship's Counsellor.

SC: Strike Cruiser.

SDAC: Starfleet Design Advisory Committee.

SFRA: Starfleet Regulatory Agency.

SIF: Structural Integrity Field. The energy field that supplements the physical support of a vessel's spaceframe.

SMP: Sensor Monitoring Position.

spaceframe: The primary structural members of the ship. The assembly of the first major spaceframe members of a ship is referred to as the "keel laying".

squibb launcher: A self-contained automated loading/launching system that fires small torpedo-like projectiles such as antimatter charges or communication beacons.

starboard: The right side of the ship when facing the bow.

stem: The foremost point of the ship (usually 0x0y0z in ship's coordinate system).

stern: The rear part of the ship.

TCS: Torpedo Control Subprocessor.

TMA: Target Motion Analysis. Establishing sufficeint course track and identification to provide a firing solution to a target.

TSO: Tactical Systems Officer.

typ: Abbrevaition for typical. Indicates one of several similar features in a drawing.

UV: Ultra-Violet.

VAG: Variable Gravity Area. A compartment where the synthetic gravity can be altered by an occupant of that compartment.

VED: Vectored Exhaust Director. Part of the IPS.

ventral: The lower surface or "underside" of the ship.

VR: Virtual Reality. A system of sensory inputs that provides a convincing simulation of reality.

WO1 (2): Abbrevaition for Warrant Officer 1 or 2.

WPS: Warp Propulsion System.

Appendix B
Nominal Ship's Complement

Below are the standard billets for the *Khai Tam*. The *Khai Tam* may have more or less people aboard at any given time, but the figures below are a good average. The ranks shown are indicative of the usual rank filling that position, the actual rank may vary. Duty stations may also vary.

Position (Rank)	Quantity	Normal Duty Station (shift)	Alert Duty Station
Command			
Commanding Officer (Capt)	1	Main Bridge (1st)	CIC
Executive Officer (Cmdr)	1	Main Bridge (1st)	CIC
Navigation Officer (Lt)	1	Main Plot (1st)	Main Bridge
Flight Controllers (Ens)	5	Main Bridge (1 per 2nd/3rd); CIC (1 per)	Damage Control
Personnel/JAG Officer (Lt)	1	Admin. Offices (1st)	Lifeboat Officer
Yeoman (enlisted)	8	varies	Emergency Medicine
Disbursing Clerk (enlisted)	1	Admin. Offices (2nd/3rd)	Emergency Medicine
OFFICERS	9		
CREW	9		
TOTAL	18		
Engineering			
Chief Engineer (Lt Cmdr)	1	Main Engineering (1st)	Main Engineering
Warp Propulsion Engineer (Lt)	1	Main Engineering (2nd)	Main Engineering
Warp Prop. Chief (≥ CPO)	2	Main Engineering (1st/3rd)	1 per Port/Stbd Nacelle
Warp Prop. Spec. (enlisted)	6	Main Engineering (2 per)	2 per Port/Stbd Nacelle

Impulse Propulsion Engineer (Lt)	1	Main Engineering (3rd)	Impulse Engineering
Impulse Prop. Chief (≥ CPO)	2	Main Engineering (1st/2nd)	1 per Port/Stbd Nacelle
Impulse Prop. Spec. (enl)	12	Impulse Engineering (4 per)	4 per Imp. Eng. Room
Thruster/RCS Spec. (enl)	6	Impulse Engineering (2 per)	Emg. Thruster Cntl.
Power Distribution Engineer (Ens)	1	Main Engineering (1st)	Main Engineering
Power Distribution Chief (≥ CPO)	2	Main Engineering (2nd/3rd)	Main Engineering
Power Distribution Spec. (enl)	6	Main Engineering (2 per)	Damage Control
Computer Systems Engineer (Lt)	1	Computer Control (1st)	Computer Control
Comp. Software Engineer (Ens)	1	Computer Control (2nd)	Computer Control
Software Chief (≥ CPO)	2	Computer Control (1st/3rd)	1 per Core (2 per)
Programmers/Operators (enl)	30	4 Comp. Cntl.;3 per Core (10 per)	5 per core;Damage Control
Comp. Hardware Engineer (Ens)	1	Computer Control (3rd)	Computer Control
FTL Processor Tech. (enl)	6	1 per Core (2 per)	3 per Core
Computer Technicians (enl)	15	varies (5 per)	Damage Control
Structural Integrity Officer (Lt jg)	1	Damage Control Center (1st)	Damage Control Center
Hull & Frame Chief (≥ CPO)	1	Damage Control Center (3rd)	Damage Control
Hull & Frame Specialist (enl)	9	Damage Control Center (3 per)	Damage Control
SIF/IDF Chief (≥ CPO)	1	Damage Control Center (2nd)	Damage Control
SIF/IDF Specialist (enlisted)	9	Damage Control Center (3 per)	Damage Control
Damage Control Chief (≥ CPO)	1	Damage Control Center (1st)	Damage Control
Damage Control Spec. (enl)	15	Damage Control Center (5 per)	Damage Control
Environmental Eng. Officer (Lt)	1	Env. Eng. Office (1st)	Env. Eng. Office
Gravity Systems Chief (≥ CPO)	1	Env. Eng. Office (3rd)	Env. Eng. Office
Gravity Systems Spec. (enl)	6	Env. Eng. Office (2 per)	Damage Control
Atmosphere Sys. Chief (≥ CPO)	1	Env. Eng. Office (2nd)	Env. Eng. Office
Atmosphere Sys.Spec. (enl)	6	Env. Eng. Office (2 per)	Damage Control
Support Systems Chief (≥ CPO)	1	Env. Eng. Office (1st)	Env. Eng. Office
Waste Recovery Tech. (enl)	6	Waste Recovery (1st)	Damage Control
Quart. & Rep. Tech. (enl)	6	Env. Eng. Office (2 per)	Damage Control
Transporter Systems Engineer (Ens)	1	Transporter Room 1 (1st)	Transporter Room 1
Transporter Chief (≥ CPO)	2	Transporter Room 1 (2nd/3rd)	Emg. Transporters
Trans. Operator-Tech. (enl)	36	1 per Trans. Rm. (12 per)	Emg. Transporters
Auxiliary Engineering Officer (Lt)	1	Aux. Engineering Office (1st)	Aux. Engineering Office
Auxiliary Eng. Spec. (enl)	30	varies	varies

OFFICERS	11
CREW	221
TOTAL	233

Security

Chief of Security (Lt Cmdr)	1	Main Bridge (1st)	CIC
Internal Security Officer (Lt jg)	1	Main Bridge (3rd)	Security Office/Brig
Internal Security Chief (≥ CPO)	3	Security Office/Brig (1 per)	Security Office/Brig
Pers. Protection Spec. (enl)	9	Patrol/Assignment (3 per)	Restricted Area Sentries
Sec. Monitoring Tech. (enl)	3	Security Office/Brig (1 per)	Security Office/Brig
Small Arms Spec. (enl)	6	1 per Armory (2 per)	2 per Armory (2 per)
Classification Tech. (enl)	3	Security Office/Brig (1 per)	Restricted Area Sentries
External Security Officer (Lt)	1	Main Bridge (2nd)	Main Bridge
Tactical Systems Officer (Lt)	1	CIC (1st)	CIC
Tactical Sensor Spec. (enl)	6	CIC (2 per)	Damage Control
Fire Control Specialist (enl)	3	CIC (1 per)	CIC

Gunnery Officer (Ens)	1	CIC (2nd)	Phaser Control
Phaser Chief (≥ CPO)	3	Phaser Control (1 per)	Ventral;Dorsal Emitters
Phaser Technicians (enl)	15	1 per Emitter (5 per)	2 more per Emitter
Disruptor Chief (≥CPO)	3	Disruptor Control (1 per)	Port;Stbd. Disruptors
Disruptor Technicians (enl)	6	1 per Disruptor (2 per)	2 more per Disruptor
Torpedo Officer (Ens)	1	CIC (3rd)	Main Torp. Bay
Torpedo Chief (≥ CPO)	3	Main Torp. Bay (1 per)	Main Torp. Bay; Aft. Ctr. Torp. Bay
Torpedo Loaders (enlisted)	18	1 per bay (1 per)	1 per tube; Damage Cntl.
Deflector Shield Chief (≥ CPO)	3	Shield Control (1 per)	Emr. Shield Cntl.
Shield Technicians (enlisted)	6	Shield Control (2 per)	Emr. Shield Cntl.
MSG Commander (Cpt)	1	MSG Office (1st)	MSG Office
Platoon Leader (2nd Lt)	2	MSG Office (2nd/3rd)	w/Platoon (Assignment)
Squad Leader (≥ Sgt)	9	Escort (1 per);Sentry (2 per)	w/Platoon (Assignment)
Light Weapons Spec. (enl)	27	Escort (3 per);Sentry (6 per)	w/Platoon (Assignment)
Heavy Weapons Spec. (enl)	9	Escort (1 per);Sentry (2 per)	w/Platoon (Assignment)
Combat Corpsman (enl)	9	Escort (1 per);Sentry (2 per)	w/Platoon (Assignment)
Pilots (≥ WO2)	2	Hangar/Flight Deck (2 per)	1 per Craft

OFFICERS	11
CREW	144
TOTAL	155

Communications

Ship's Comm. Officer (Lt Cmdr)	1	Comm Center (1st)	Comm Center
Internal Comm. Officer (Ens)	1	Comm Center (3rd)	Comm Center
Intraship Comm. Chief (≥CPO)	3	Comm Center (1 per)	Damage Control
Intraship Comm. Tech. (enl)	6	Comm Center (2 per)	Damage Control
Media Production Chief (≥ CPO)	1	Media Prod. Office (1st)	Emergency Medicine
Newsletter Editor (civilian)	1	Media Prod. Office (1st)	Emergency Medicine
Writer/Imager (civilian)	3	Media Prod. Office (1st)	Emergency Medicine
Holo Production Supv. (enl)	1	Media Prod. Office (1st)	Emergency Medicine
Holo Production Crew (enl)	4	Media Prod. Office (1st)	Emergency Medicine
External Comm. Officer (Lt jg)	1	Comm Center (2nd)	Comm Center
External Comm. Chief (≥CPO)	3	Comm Center (1 per)	Damage Control
Subspace Radio Spec (enlisted)	6	Comm Center (2 per)	Damage Control
RF/Optic Radio Spec (enlisted)	3	Comm Center (1 per)	Damage Control
Crypto Technicians (enlisted)	3	Comm Center (1 per)	Damage Control
Datalink Spec. (enlisted)	3	Comm Center (1 per)	Damage Control

OFFICERS	3
CREW	33
CIVILIAN	4
TOTAL	40

Shuttle Ops

Shuttle Wing Commander (Lt Cmdr)	1	PriFlight (1st)	PriFlight
Shuttle Ops Officers (Lt)	2	PriFlight (2nd/3rd)	PriFlight
Traffic Controllers (enlisted)	9	PriFlight (3 per)	Damage Control
Flight Deck Officers (Ens)	6	1 per shuttlebay (2 per)	3 per shuttlebay
Flight Deck Specialists (enl)	9	2 Main; 1 Shuttlebay 2 (3 per)	Damage Control
Aux. Craft Maint. Engineer (Ens)	1	Main Shuttlebay (1st)	Main Shuttlebay
Aux. Craft Maint. Chief (≥ CPO)	2	Main Shuttlebay (2nd/3rd)	1 per Shuttlebay
Aux. Craft Maint. Tech. (enl)	21	5 Main; 2 Shuttlebay 2 (7 per)	10 Main/4 Shuttlebay 2 (14 per)
Pilot Commander (Lt)	1	Main Shuttlebay (1st)	Runabout 1
Shuttlepod Pilot-Tech. (enl)	25	varies	1 per Craft; Damage Control
Pers./Cargo Pilots (Ens/WO2)	25	varies	1 per Craft ; Damage Control
Runabout Pilots (Lt/SWO)	3	Main Shuttlebay (varies)	2 per Craft (incl. Pilot Cmdr.)
Runabout Crewchiefs (≥ CPO)	2	Main Shuttlebay (varies)	1 per Craft
GT1 Pilots (≥ WO2)	6	Main Shuttlebay (2 per)	1 per Craft
QRPV1 Pilot-Techs (≥ WO2)	5	Main Shuttlebay (1st)	Main Shuttlebay
QRPV2 Pilot-Techs (≥ WO2)	5	Main Shuttlebay (1st)	Main Shuttlebay

OFFICERS	75
CREW	67
TOTAL	142

Science

Science Officer (Lt Cmdr)	1	Science Complex (1st)	Science Complex
Physicist (Lt)	1	Science Complex (1st)	Science Complex
Subatom./Quan. Phys. (Ens/WO2)	1	Science Complex (1st)	Science Complex
SQP Lab Chief (≥ CPO)	2	Science Complex (2nd/3rd)	Emergency Medicine
SQP Specialist (enlisted)	9	Science Complex (3 per)	Emergency Medicine
Astrophysicist (Ens/WO2)	1	Science Complex (1st)	Science Complex
Astro Lab Chief (≥ CPO)	2	Science Complex (2nd/3rd)	Emergency Medicine
Astro Specialist (enlisted)	9	Science Complex (3 per)	Emergency Medicine
Subspace Physicist (Ens/WO2)	1	Science Complex (1st)	Science Complex
SSP Lab Chief (≥ CPO)	2	Science Complex (2nd/3rd)	Emergency Medicine
SSP Specialist (enlisted)	9	Science Complex (3 per)	Emergency Medicine
Gravimetric Physicist (Ens/WO2)	1	Science Complex (1st)	Science Complex
GP Specialist (enlisted)	6	Science Complex (2 per)	Emergency Medicine
High Energy Physicist (Ens/WO2)	1	Science Complex (1st)	Science Complex
HEP Specialist (enlisted)	6	Science Complex (2 per)	Emergency Medicine
General Phys. Lab Chief (≥ CPO)	1	Science Complex (1st)	Science Complex
GPL Specialist (enlisted)	2	Science Complex (2nd/3rd)	Science Complex
Planetary Geologist (Lt jg/WO1)	1	Science Complex (1st)	Science Complex
Geophysicist (Ens/WO2)	1	Science Complex (1st)	Science Complex
Geophysics Specialist (enlisted)	3	Science Complex (1 per)	Emergency Medicine
Geochemist (Ens/WO2)	1	Science Complex (1st)	Science Complex
Geochemistry Spec. (enlisted)	3	Science Complex (1 per)	Emergency Medicine
Oceanographer (WO2)	1	Science Complex (1st)	Emergency Medicine
Meteorologist (Ens/WO2)	1	Science Complex (1st)	Science Complex
Meteorology Spec. (enlisted)	3	Science Complex (1 per)	Emergency Medicine

A&A Officer (Ens/WO2)	1	Science Complex (1st)	Science Complex
A&A Specialists. (enlisted)	3	Science Complex (1st)	Science Complex
Cartography Officer (Lt jg/WO1)	1	Science Complex (1st)	Science Complex
Stellar Cartography Tech. (enl)	3	Science Complex (1 per)	Emergency Medicine
Planetary Cart. Tech. (enlisted)	3	Science Complex (1 per)	Emergency Medicine
Chemistry Officer (Ens/WO2)	1	Science Complex (1st)	Science Complex
Analytical Chem. Spec (enlisted)	3	Science Complex (1 per)	Emergency Medicine
Polymer Chem. Spec (enlisted)	1	Science Complex (1st)	Emergency Medicine
Synthetic Chem. Spec (enlisted)	1	Science Complex (1st)	Emergency Medicine
Physical Chem. Spec. (enlisted)	3	Science Complex (1 per)	Emergency Medicine
General Science Lab Officer (Lt jg)	1	Science Complex (1st)	Science Complex
Gen. Sci. Lab Chief (≥ CPO)	2	Science Complex (2nd/3rd)	Emergency Medicine
Gen. Sci. Lab Tech. (enlisted)	9	Science Complex (3 per)	Emergency Medicine

OFFICERS	16
CREW	85
TOTAL	101

Medical

Chief Medical Officer (Cmdr)	1	see chapter 13	Sickbay Complex
Ship's Counselor (Lt Cmdr)	1	see chapter 13	Sickbay Complex
Ship's Dentist (Lt)	1	see chapter 13	Sickbay Complex
Dental Technicians (enlisted)	2	see chapter 13	Sickbay Complex
Staff Physicians (Lt)	3	see chapter 13	Sickbay/Emer. Shelter
Head Nurse (Lt)	1	see chapter 13	Sickbay Complex
Duty Nurses (Ens)	5	see chapter 13	Sickbay/Emer. Shelter
Medical Technicians (enlisted)	11	see chapter 13	Sickbay/Emer. Shelter
Medical Lab Tech. (enlisted)	4	see chapter 13	Sickbay/Emer. Shelter
Physical Therapist (enlisted)	1	see chapter 13	Sickbay Complex
Scrub Nurse (Lt. jg)	1	see chapter 13	Sickbay Complex
Ship's Pharmacist (Ens)	1	see chapter 13	Sickbay Complex
Life Sciences Officer (Lt)	1	Science Complex (1st)	Science Complex
Biology Officer (Ens/WO2)	1	Science Complex (3rd)	Science Complex
Biochemistry Spec (enlisted)	1	Science Complex (1st)	Emergency Medicine
Biophysics Spec (enlisted)	1	Science Complex (1st)	Emergency Medicine
Exobiology Spec (enlisted)	3	Science Complex (1 per)	Emergency Medicine
Microbiology Spec (enlisted)	3	Science Complex (1 per)	Emergency Medicine
Zoologist/Veterinarian (Lt jg)	1	Science Complex (2nd)	Science Complex
Zoology Lab Tech. (enlisted)	2	Science Complex (1st/3rd)	Emergency Medicine
Botanist (Ens/WO2)	1	Science Complex (1st)	Science Complex
Botany Lab Tech. (enlisted)	2	Science Complex (2nd/3rd)	Emergency Medicine

OFFICERS	18
CREW	30
TOTAL	48

Ops

Operations Manager (Cmdr)	1	Main Bridge (1st)	CIC
Operations Watch Officers (Lt Cmdr)	2	Main Bridge (2nd/3rd)	Main Bridge; Ops Office
Ops Liaison Officers (Lt)	4	varies	varies
Resource Allocation Officer (Lt)	3	Ops Office (1 per)	Emergency Medicine
Resource Alloc. Spec. (enl)	9	Ops Office (3 per)	Emergency Medicine

OFFICERS	10
CREW	9
TOTAL	19

Auxiliary Services

Auxiliary Services Officer (Lt Cmdr)	1	Aux Office (1st)	Lifeboat Officer
Ship's Habitability Officer (Lt)	1	Aux Office (1st)	Lifeboat Officer
Lounge/Dining Staff (civilian)	24	Lounge (8-1st;12-2nd;4-3rd)	Emergency Medicine
Barber (civilian)	2	Ship's Barber Shop (1st/2nd)	Emergency Medicine
Storekeeper (civilian)	4	Ship's Store (1-1st;2-2nd;1-3rd)	Emergency Medicine
CQS Officer (Ens)	1	Aux Office (1st)	Damage Control
CQS Specialists (enlisted)	4	varies	Damage Control
Food Rep. Spec. (enlisted)	3	Food Replicator Control (1 per)	Damage Control
Recreation Officer (Ens)	1	Aux Office (1st)	Lifeboat Officer
Holodeck Chief (≥ CPO)	2	Aux Office (2nd/3rd)	Emergency Medicine
Holodeck Programmers(enl)	4	Aux Office (1st)	Emergency Medicine
Recreational Prog. Coord. (civ)	1	Gymnasium (2nd)	Emergency Medicine
Recreation Staff (civilian)	5	varies	Emergency Medicine
Special Events Coord. (≥ CPO)	1	Aux Office (1st)	Emergency Medicine
Special Events Staff (civilian)	6	varies	Emergency Medicine
Ship's Education Officer (Lt)	1	Training Office (1st)	Lifeboat Officer
Prof. Dev. Staff (Ens)	2	Training Office (1st/2nd)	Emergency Medicine
Trng. Holodeck Coord. (≥ CPO)	1	Training Office (1st)	Emergency Medicine
Training Holodeck Prog. (enl)	4	Training Office (1st)	Emergency Medicine
Family School Director (civilian)	1	Ship's School (1st)	Emergency Child Care
Teachers (civilian)	2	Ship's School (1st)	Emergency Child Care

OFFICERS	7
CREW	19
CIVILIAN	45
TOTAL	53

Summary

Officers (Commissioned & Warrant)	160	
Enlisted Personnel	617	
TOTAL SHIP'S COMPLEMENT	777	(officer:crew ratio = 1:4 (Starfleet avg = 1:5))
Plus Normal Family Billet	78	
TOTAL SHIP'S POPULATION	855	

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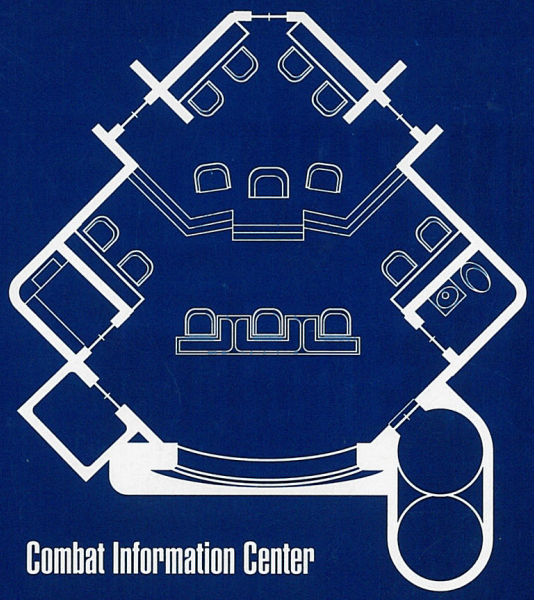

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